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code of federal regulations

Energy

10

PARTS 400 TO 499

Revised as of January 1, 1991

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PARTS 400 TO 499

Revised as of January 1, 1991

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AS OF JANUARY 1, 1991

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Cite this Code: **CFR**

To cite the regulations in this volume use title, part and section number. Thus, **10 CFR 417.1** ***refers to title 10, part 417, section 1.***

Explanation

The Code of Federal Regulations is a codification of the general and permanent rules published in the Federal Register by the Executive departments and agencies of the Federal Government. The Code is divided into 50 titles which represent broad areas subject to Federal regulation. Each title is divided into chapters which usually bear the name of the issuing agency. Each chapter is further subdivided into parts covering specific regulatory areas.

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Each volume of the Code is revised at least once each calendar year and issued on a quarterly basis approximately as follows:

Title 1 through Title 16	as of January 1
Title 17 through Title 27	as of April 1
Title 28 through Title 41	as of July 1
Title 42 through Title 50	as of October 1

The appropriate revision date is printed on the cover of each volume.

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The Paperwork Reduction Act of 1980 (Pub. L. 96-511) requires Federal agencies to display an OMB control number with their information collection request. Many agencies have begun publishing numerous OMB control numbers as amendments to existing regulations in the CFR. These OMB numbers are placed as close as possible to the applicable recordkeeping or reporting requirements.

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What is incorporation by reference? Incorporation by reference was established by statute and allows Federal agencies to meet the requirement to publish regulations in the Federal Register by referring to materials already published elsewhere. For an incorporation to be valid, the Director of the Federal Register must approve it. The legal effect of incorporation by reference is that the material is treated as if it were published in full in the Federal Register (5 U.S.C. 552(a)). This material, like any other properly issued regulation, has the force of law.

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Rules (Table I), and Acts Requiring Publication in the Federal Register (Table III). A list of CFR titles, chapters, and parts and an alphabetical list of agencies publishing in the CFR are also included in this volume.

An index to the text of "Title 3—The President" is carried within that volume.

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Martha L. Girard,
Director,
Office of the Federal Register.

January 1, 1991.

THIS TITLE

Title 10—ENERGY is composed of five volumes. The parts in these volumes are arranged in the following order: Parts 0-50, 51-199, 200-399, 400-499 and Part 500-End. The first and second volumes containing Parts 0-199 are comprised of Chapter I— Nuclear Regulatory Commission. The third, fourth, and fifth volumes containing Part 200-End are comprised of Chapters II, III and X—Department of Energy and Chapter XV—Office of the Federal Inspector for the Alaska Natural Gas Transportation System. The contents of these volumes represent all current regulations codified under this title of the CFR as of January 1, 1991.

For this volume Linda L. Jones was Chief Editor. The Code of Federal Regulations publication program is under the direction of Richard L. Claypoole, assisted by Alomha S. Morris.

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Title 10—Energy

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SUBCHAPTER D—ENERGY CONSERVATION

PARTS 400-416—[RESERVED]

PART 417—WIND ENERGY TECHNOLOGY APPLICATION PROGRAM

Subpart A—General

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417.21 Scope.
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417.27 Visitation.

Authority: Sec. 6, Pub. L. 96-345, 94 Stat. 1142 (42 U.S.C. 9205); 41 U.S.C. 506(a).

Source: 47 FR 16167, Apr. 15, 1982, unless otherwise noted.

Subpart A—General

§ 417.1 Purpose and scope.

The purposes of this part are to establish a wind energy technology application program under section 6 of the Wind Energy Systems Act of 1980 (Pub. L. 96-345) and to set forth the procedures and requirements for the award and administration of financial assistance (in the form of grants or cooperative agreements) to public and private entities for the purchase and installation of large wind energy systems and data-gathering on operation and maintenance of such systems. The procedures and requirements of this part do not apply to the research, development, and demonstration projects eligible to receive DOE financial assistance under the Act, to loans to finance purchase and installation of large wind energy systems, or to arrangements made by DOE with other Federal agencies for the procurement of wind energy systems.

§ 417.2 Definitions.

For the purposes of this part—

"Act" means the Wind Energy Systems Act of 1980, Pub. L. 96-345.

"Conventional energy source" means energy produced from oil, gas, coal, or nuclear fuels.

"DOE" means the Department of Energy.

"Feasibility study" means a study to determine the technical and economic feasibility and institutional and environmental acceptability of undertaking a project to purchase and install a wind energy system at a specific site.

"Financial assistance" means a grant or cooperative agreement.

"Normal operation" means the unattended operation of the wind energy system after installation and debugging and putting energy from the system on line.

"Operating and maintenance costs" means those costs incurred after commencement of normal operation associated with maintaining a wind energy system so that it continues to perform satisfactorily over its design lifetime.

"Peak generating capacity" means the maximum power output a wind system is capable of producing in normal operation.

"Public or private entity" means any individual, corporation, partnership, firm, association, agricultural cooperative, public or investor owned utility, public or private institution or group, and state or local government agency, or any other domestic entity.

"Secretary" means the Secretary of Energy.

"Small Wind energy system" means a wind energy system designed to produce a peak generating capacity of one hundred kilowatts or less.

"State" means the fifty States, the District of Columbia, the Commonwealth of Puerto Rico, the Commonwealth of the Northern Mariana Islands, and the territories and possessions of the United States including the Trust Territory of the Pacific Islands.

"Wind energy system" means a system of components which converts the kinetic energy of the wind into electricity or mechanical power and which comprises all necessary components including energy storage, power conditioning, control systems, and transmission systems, where appropriate, to provide electricity or mechanical power for residential, agricultural, commercial, industrial, utility or governmental use.

§ 417.3 Establishment of program.

(a) The Wind Energy Technology Application Program is established under this part and shall be administered by the Assistant Secretary of Conservation and Renewable Energy of DOE.

(b) DOE shall not issue any solicitation or award any financial assistance related to large wind energy systems under this part after finding, in accordance with section 6 of the Act, that such systems have become economically competitive with conventional energy sources or on September 30, 1988, whichever occurs first.

§ 417.4 Eligibility requirements.

Any public or private entity is eligible to receive assistance under this part for a project located within a State which involves one or more large wind energy systems, each of which has a peak generating capacity of greater than one hundred kilowatts.

§ 417.5 Applicability of DOE Assistance Regulations.

Except as otherwise provided in these rules, the award and administration of financial assistance under this part are subject to the requirements of the DOE Assistance Regulations, 10 CFR Part 600.

§ 417.6 Solicitation procedures.

(a) Subject to the availability of appropriated funds or to termination of all or part of the program, as provided in § 417.3(b), DOE may issue solicitations under this section as often as it deems appropriate. DOE shall not consider any unsolicited proposal for assistance under this part.

(b) Subsequent to publishing a notice of availability under paragraph (c) of this section, DOE shall solicit pre-applications and/or applications for the award of financial assistance under this part by issuing a solicitation providing the following information:

(1) Program name, reference title and number of this program in the Catalog of Federal Domestic Assistance, citations to these rules, and to the statutory authority for this program;

(2) Name and address of the DOE official or office to which the application should be mailed or delivered;

(3) Deadlines for submitting pre-applications and applications, and for completing reviews under Part I of OMB Circular A-95;

(4) Number of copies, not exceeding three, of pre-applications and/or applications required to be submitted.

(5) A description of how DOE will treat late applications, and how DOE intends to dispose of applications that do not result in the award of financial assistance;

(6) Total amount of DOE funds available for award under the solicitation, the maximum amount of DOE assistance that may be awarded to an individual recipient, and the minimum amount of cost sharing required to be provided by the applicant;

(7) A statement advising applicants that, except as otherwise provided in these rules, the award and administration of financial assistance under this part are subject to the DOE Assistance Regulations, 10 CFR Part 600;

(8) A statement advising that information submitted to DOE in pre-applications and applications is subject to reproduction or disclosure to others under the DOE regulations implementing the Freedom of Information Act, 5 U.S.C. 552, 10 CFR Part 1004;

(9) A statement advising that the award and administration of financial assistance under this part are subject to the requirements of 10 CFR Part 1022 (Compliance with Floodplain/Wetlands Environmental Review Requirements) and the requirements of 10 CFR Part 1040 (Non-discrimination in Federally Assisted Programs);

(10) Date, time and location of any pre-application briefing;

(11) A statement advising applicants of the availability of the debriefing procedure under § 417.7;

(12) A statement indicating whether DOE intends to award the financial assistance in the form of grants, cooperative agreements, or a combination of these instruments;

(13) A description of the eligibility requirements applicable to the solicitation;

(14) An explanation of the criteria that will be used to evaluate applications and the ranking of such evaluation criteria;

(15) A summary of and references to the standard terms and conditions that will be included in the financial assistance agreement;

(16) Name, address, and telephone number of the DOE official from whom applicants may obtain applications and additional information, including copies of these rules and any materials referred to in the solicitation.

(c) Prior to issuing a program solicitation, DOE shall publish in the FEDERAL REGISTER and Commerce Business Daily a Notice of Availability, including but not limited to the information described in § 417.6(c) (1), (6), (12), (13), and (14).

(d) Whenever necessary to assure adequate publicity and widespread participation, DOE may publish a copy or notice of the solicitation in trade and professional journals and in newspapers, and may mail copies or notices directly to potential applicants.

(e) In any solicitation issued under this section, DOE reserves the right to award financial assistance to any, all, or none of the applicants.

§ 417.7 Debriefing.

Upon the written request of an applicant whose application has been disapproved, DOE may schedule a telephone conference or a meeting for the purpose of explaining why the applicant's project was not approved for assistance under this part. Such debriefing must be requested within 30 days after date of the written notification of DOE disapproval.

§ 417.8 Property.

Unless otherwise provided in the assistance agreement, title to wind data-gathering equipment and to all large wind energy systems acquired with financial assistance provided under this part shall vest in the recipient without any further accountability to the Federal government. This section does not affect the obligation of the recipient to comply with the monitoring and reporting requirements of § 417.26 and the visitation requirement of § 417.27.

Subpart B—Financial Assistance for Large Wind Energy Systems

§ 417.21 Scope.

This subpart sets forth special procedures and requirements governing the application and award of financial assistance for the purchase and installation of large wind energy systems, as well as data-gathering and reporting on operation and maintenance of such systems.

§ 417.22 Funding limitation.

Except as otherwise provided by statute enacted subsequent to issuance of these rules,

(a) Before October 1, 1986, the amount of DOE assistance awarded under this subpart may not exceed 50 percent of total allowable project costs; and

(b) After September 30, 1986, the amount of DOE assistance awarded under this subpart may not exceed 25 percent of total allowable project costs.

§ 417.23 Application requirements.

An application for financial assistance to purchase and install a large wind energy system shall include the following:

(a) A project description which includes a feasibility study containing the following elements—

(1) A wind resource assessment based on reliable wind speed data collected and recorded, at the proposed site, by an acceptable method and for a minimum period of time which are specified in the program solicitation;

(2) An economic analysis determining the estimated cost of wind-generat-

ed energy (cents per kilowatt hour) as a function of—

(i) The available wind resources;

(ii) The anticipated performance of the large wind energy system;

(iii) The estimated costs of site acquisition and preparation, wind energy system purchase and installation, interconnection and transmission, and operation and maintenance; and

(iv) The estimated revenues or value to be derived from wind-generated energy;

(3) A marketing plan which identifies prospective purchasers and estimates the volume of sales of wind-generated energy;

(4) An engineering analysis identifying—

(i) The optimum location;

(ii) Configuration;

(iii) Expected system performance; and

(iv) Plans for site preparation, transportation of system components to the site, installation, power system interconnection and operation;

(5) A power system integration plan describing—

(i) Components and subsystems; and

(ii) The schedule and procedures to be undertaken to comply with requirements of relevant regulatory and financial institutions;

(6) A site development plan describing the schedule and procedures for acquiring—

(i) Licenses;

(ii) Permits; and

(iii) Any necessary property interests including land, structures, rights-of-way, access roads, and air rights;

(7) An environmental analysis evaluating all potential adverse environmental effects of installation and operation and determining alternative, cost-effective mitigating procedures;

(8) A health and safety analysis identifying occupational and public health and safety issues associated with installation and operation, and determining alternative cost-effective mitigating procedures; and

(9) A financing plan identifying—

(i) Sources and amounts of financing for construction and operation;

(ii) A cash flow statement for the first five-years of system operation;

(iii) Assumptions regarding interest rates, tax liabilities, and debt amortization.

(b) The number and type of proposed large wind energy systems to be purchased and installed including meteorological equipment;

(c) The names, addresses, qualifications, and experience of the manufacturers, designers, and installers of the principal components of the proposed large wind energy system, including meteorological equipment;

(d) The number, length, voltage, interconnection, age, condition and location of any transmission lines to be constructed or modified as part of the project, including any new facilities required to put energy from the wind system on line;

(e) Topographical maps, diagrams, site plan, and photographs showing the location of the proposed project;

(f) A statement indicating whether the applicant has applied for or plans to apply for any other Federal assistance to support the proposed project;

(g) A management plan identifying the major tasks involved in completing the project, the qualifications and responsibilities of key personnel, and the estimated schedule of completion, including projected dates for obtaining necessary permits and licenses; and

(h) A title report or other documentary evidence that the applicant will have access to and be authorized to use the proposed site for at least 30 years following the end of the project period.

EFFECTIVE DATE NOTE: Section 417.23 contains information collection requirements which will not be effective until OMB approval has been obtained. Section 417.23 was published at 47 FR 16167, Apr. 15, 1982.

§ 417.24 Allowable project costs.

(a) Allowable project costs under this subpart shall include all reasonable and necessary expenses of purchasing and installing a large wind energy system. Such costs shall include expenses incurred for site preparation and for purchase, delivery, storage, assembly, installation, and start-up testing of all essential system components, and for the monitoring and reporting required under § 417.26 of this subpart.

(b) Allowable transmission system costs may not exceed 10 percent of total allowable large wind energy systems costs. If the applicant demonstrates that the existing transmission system is not adequate to transport electricity from a large wind energy system to an electric power grid, the costs of such transmission system may be allowed up to a maximum of 25 percent of total allowable system costs.

§ 417.25 Evaluation criteria.

(a) Based on information provided in the application and on any other information available to DOE, the criteria used to evaluate applications for assistance under this subpart shall include the following:

(1) Wind resource at the proposed site;

(2) The extent of cost-sharing proposed by the applicant;

(3) Demonstrated level of performance and reliability of the proposed large wind energy system;

(4) Technical and economic feasibility;

(5) Institutional and environmental acceptability;

(6) Commercial readiness of the proposed energy system;

(7) Ability of the applicant to manage the project, to finance its share of the purchase and installation costs, and to pay for the operation and maintenance of the completed system;

(8) Suitability of the proposed site; and

(9) The relative contribution the proposed large wind system would make to the reduction of unit costs of production and the objectives set forth in section 2(b) of the Act.

(b) Assistance applications for large wind energy systems with an aggregate peak generating capacity of less than 30 megawatts shall be evaluated competitively against each other. Applications proposing projects designed to generate 30 megawatts or more of power shall be competitively evaluated against each other.

§ 417.26 Monitoring and reporting requirements.

(a) For five years after the commencement of normal operation, the assistance recipient shall monitor and report to DOE the following data:

(1) Site meteorological data;

(2) System performance and energy produced;

(3) Actual operating and maintenance costs;

(4) Types and quantities of fuel from conventional energy source displaced by the wind-generated energy.

(5) Such other items of data as described in the assistance agreement.

(b) The information required to be reported under this section shall be submitted on a form or consistent with instructions provided by DOE. The reporting frequency established by DOE in the assistance agreement shall not be less frequently than annually nor more frequently than quarterly.

(c) DOE reserves the right to modify the reporting requirements of this section on a case-by-case basis to reflect variations in the nature, size, scope, instrumentation, and management of the assisted project.

(d) The recipient shall make the project site available to authorized DOE employees or agents for the performance, at DOE expense, of on-site sampling, testing, and monitoring.

EFFECTIVE DATE NOTE: Section 417.26 contains information collection requirements which will not be effective until OMB approval has been obtained. Section 417.26 was published at 47 FR 16167, Apr. 15, 1982.

§ 417.27 Visitation.

The financial assistance agreement shall specify the procedures the recipient will establish for providing opportunities for members of the public to view and inspect the system under reasonable conditions.

PART 420—STATE ENERGY CONSERVATION PROGRAM

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420.3 Financial assistance.
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420.5 Review and approval of annual State applications and State plans.
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420.8 Extensions for compliance with required program measures.
420.9 Administrative review.
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420.11 Reports.
420.12 Prohibited expenditures.
420.13 Administration of financial assistance.

AUTHORITY: Title III, Part C, as amended, of the Energy Policy and Conservation Act (42 U.S.C. 6321 *et seq.*); Department of Energy Organization Act (42 U.S.C. 7101 *et seq.*).

SOURCE: 48 FR 39360, Aug. 30, 1983, unless otherwise noted.

§ 420.1 Purpose and scope.

(a) This part prescribes requirements for program measures included in plans and supplemental plans, and guidelines for the development, modification and funding of plans and supplemental plans. It is the purpose of this part to promote the conservation of energy and to reduce the rate of growth of energy demand through the development and implementation of a comprehensive State energy conservation plans program and the provision of Federal financial and technical assistance to States in support of such program.

(b) DOE has the responsibility to foster and promote comprehensive State energy conservation plans by providing technical and financial assistance for specific State intiatives to conserve and improve efficiency in the use of energy and to encourage the use of renewable resources. Because of the diversity of conditions among the various States and regions of the Nation, a wholly Federally administered program would not be as effective as one which is tailored to meet local requirements and to respond to local opportunities.

§ 420.2 Definitions.

As used in this part:

Act means Title III, Part C, as amended, of the Energy Policy and Conservation Act, 42 U.S.C. 6321 *et seq.*

ASHRAE 90-75 means those designated standards developed by the American Society of Heating, Refrigerating and Air-Conditioning Engineers, Incorporated, as approved by its Board of Directors on August 11, 1975, to provide design requirements for improvements of energy utilization in new buildings.

Assistant Secretary means the Assistant Secretary for Conservation and Renewable Energy or any official to whom the Assistant Secretary's functions may be redelegated by the Secretary.

Btu means British thermal unit.

British thermal unit means the quantity of heat necessary to raise the temperature of one pound of water one degree Fahrenheit at 39.2 degrees Fahrenheit and one atmosphere of pressure.

Building means any structure which includes provision for a heating or cooling system, or both, or for a hot water system.

Carpool means the sharing of a ride by two or more people in an automobile.

Carpool matching and promotion campaign means a campaign to coordinate riders with drivers to form carpools and/or vanpools.

Commercial building means any building other than a residential building, including any building constructed for industrial or public purposes.

Deputy Assistant Secretary means the Deputy Assistant Secretary for Technical and Financial Assistance or any official to whom the Deputy Assistant Secretary's functions may be redelegated by the Assistant Secretary.

DOE means the Department of Energy.

Energy audit means a survey of a building or buildings that is conducted in accordance with § 420.7(d) and Subpart B of 10 CFR Part 450 and which:

(a) Identifies the type, size, energy use level and the major energy using systems of such building or buildings;

(b) Determines appropriate energy conservation maintenance and operating procedures; and

(c) Indicates the need, if any, for the acquisition and installation of energy conservation measures.

Energy conservation means efficient energy use or the utilization of renewable energy resources which results in energy savings based upon a net reduction in the use of non-renewable energy resources.

Energy conservation measure means a measure which is identified as an energy conservation measure in accordance with Subpart D of 10 CFR Part 450.

Energy measure means an energy conservation measure or a renewable-resource energy measure as prescribed in Subpart D of 10 CFR Part 450.

Environmental residual means any pollutant or pollution causing factor which results from any activity.

Exempted building means:

(a) Any building whose peak design rate of energy usage for all purposes is less than one watt (3.4 Btu's per hour) per square foot of floor area for all purposes;

(b) Any building with neither a heating nor cooling system;

(c) Any mobile home; or

(d) Any building owned or leased in whole or in part by the United States.

Exterior envelope physical characteristics means the physical nature of those elements of a building which enclose conditioned spaces through which thermal energy may be transferred to or from the exterior.

Governor means the chief executive officer of a State and the Mayor of the District of Columbia, or a person duly designated in writing by the Governor to act upon his or her behalf.

Grantee means the State or other entity named in the notice of grant award as the recipient.

Heating, ventilating and air-conditioning means a system that provides heating, ventilation and/or air conditioning within or associated with a building.

HUD minimum property standards means any of the rules and regulations adopted by the Department of Housing and Urban Development establishing minimum acceptable levels of site design, site preparation, exterior and interior appurtenances which standard is applied to single or multifamily housing units which seek assistance under one or more programs administered by the Assistant Secretary for Housing and Mortgage Credit of the Department of Housing and Urban Development.

HVAC means heating, ventilating and air-conditioning.

Industrial plant means any fixed equipment or facility which is used in connection with, or as part of, any process or system for industrial production or output.

Major building type means a class of buildings within which similar functions occur such as hospitals, restaurants, hotels and supermarkets.

Metropolitan Planning Organization means that organization required by the Department of Transportation, and designated by the Governor as being responsible for coordination within the State, to carry out transportation planning provisions in a Standard Metropolitan Statistical Area.

National energy conservation program means a program which is authorized by Federal statute and is wholly implemented by the Federal Government, without the active participation of a State or local government, other than for usual coordination or acknowledgement.

Operations Office Manager means the manager of a DOE Operations Office or the manager's designee, or any official to whom the manager's functions may be redelegated by the Secretary.

Park-and-ride lot means a parking facility generally located at or near the trip origin of carpools, vanpools and/or mass transit.

Petroleum violation escrow funds. For purposes of exempting petroleum violation escrow funds from the matching requirements of § 420.3(e) and § 420.12(b), "petroleum violation escrow funds" means any funds distributed to the States by the Department of Energy or any court and identified as Alleged Crude Oil Violation funds, together with any interest earned thereon by the States, but excludes any funds designated as "excess funds" under section 3003(d) of the Petroleum Overcharge Distribution and Restitution Act, Subtitle A of Title III of the Omnibus Budget Reconciliation Act of 1986, Pub. L. 99-509, and the funds distributed under the

"Warner Amendment," section 155 of Pub. L. 97-377.

Plan means a State energy conservation plan including required program measures in accordance with § 420.6 and otherwise meeting the applicable provisions of this part.

Political subdivision means a unit of government within a State, including a county, municipality, city, town, township, parish, village, local public authority, school district, special district, council of governments, or any other regional or intrastate governmental entity or instrumentality of a local government exclusive of institutions of higher learning and hospitals.

Preferential traffic control means any one of a variety of traffic control techniques used to give carpools, vanpools and public transportation vehicles priority treatment over single occupant vehicles other than bicycles and other two-wheeled motorized vehicles.

Program measure means one or more State actions, in a particular area, designed to effect energy conservation, excluding actions in areas specifically covered by national energy conservation programs.

Public building means any building which is open to the public during normal business hours, except exempted buildings, including:

(a) Any building which provides facilities or shelter for public assembly, or which is used for educational office or institutional purposes;

(b) Any inn, hotel, motel, sports arena, supermarket, transportation terminal, retail store, restaurant, or other commercial establishment which provides services or retail merchandise;

(c) Any portion of an industrial plant building used primarily as office space; or

(d) Any building owned by a State or political subdivision thereof, including libraries, museums, schools, hospitals, auditoriums, sport arenas, and university buildings.

Public transportation means any scheduled or nonscheduled transportation service for public use.

Renewable-resource energy measure means a measure which is identified as a renewable resource energy measure in accordance with Subpart D of 10 CFR Part 450.

Residential building means any structure which is constructed for residential occupancy.

Secretary means the Secretary of DOE.

State means a State, the District of Columbia, Puerto Rico, or any territory or possession of the United States.

State or local government building means any building owned and primarily occupied by offices or agencies of a State; and any building of a unit of local government or a public care institution which could be covered by Part H, Title III, of the Energy Policy and Conservation Act, 42 U.S.C. 6372-6372i.

Supplemental plan means a supplemental State energy conservation plan including required program measures in accordance with § 420.7 and otherwise meeting the applicable provisions of this part.

Transit level of service means characteristics of transit service provided which indicate its quantity, geographic area of coverage, frequency and quality (comfort, travel, time, fare and image).

Urban area traffic restriction means a setting aside of certain portions of an urban area as restricted zones where varying degrees of limitation are placed on general traffic usage and/or parking.

Vanpool means a group of riders using a vehicle, with a seating capacity of not less than eight individuals and not more than fifteen individuals, for transportation to and from their residences or other designated locations and their place of employment, provided the vehicle is driven by one of the pool members.

Variable working schedule means a flexible working schedule to facilitate carpool, vanpool and/or public transportation usage.

[48 FR 39360, Aug. 30, 1983, as amended at 53 FR 52394, Dec. 27, 1988; 55 FR 41324, Oct. 10, 1990]

§ 420.3 Financial assistance.

(a) The Operations Office Manager shall provide financial assistance to each State having an approved annual application from funds available for any fiscal year to develop, modify or implement a plan, a supplemental plan, or both.

(b) Financial assistance to develop, implement or modify plans shall be allocated among the States from funds available for any fiscal year, based on the following formula:

(1) Forty percent of available funds will be divided on the basis of the population of the participating States as contained in the most recent census documents available from the Bureau of the Census, Department of Commerce, for all participating States at the time DOE needs to compute State formula shares;

(2) Twenty-five percent of available funds will be divided among the participating States equally; and

(3) Thirty-five percent of available funds will be divided on the basis of estimated energy savings in calendar year 1980 resulting from the implementation of State energy conservation plans: provided, however, that no State shall receive more than twenty percent of the funds available to be divided on the basis of the estimated energy savings in calendar year 1980.

(c) Financial assistance to develop, implement or modify supplemental plans shall be allocated among the States from funds available for any fiscal year, based on the following formula:

(1) Seventy-five percent of available funds will be divided on the basis of the population of the participating States as contained in the most recent census documents available from the Bureau of the Census, Department of Commerce, for all participating States at the time DOE needs to compute State formula shares; and

(2) Twenty-five percent of available funds will be divided among the participating States equally.

(d) The budget period covered by the financial assistance provided to a State according to § 420.3 (b) and (c) will be set by the State within parameters established by DOE.

(e) Each State shall provide cash, in kind contributions, or both for SECP activities in an amount totalling not less than 20 percent of the financial assistance allocated to the State under paragraph (b) of this section. Cash and in-kind contributions used to meet this State cost-sharing requirement are subject to the limitations on expenditures described in § 420.12(a), but are not subject to the 20 percent limitation in § 420.12(b). The type and amount of State cost sharing shall be identified in the annual application with respect to a plan. Nothing in this paragraph shall be read to require a match for petroleum violation escrow funds used under this part.

(f) Subawards which are included in a State's approved SECP plan or supplemental plan are authorized under this part.

[48 FR 39360, Aug. 30, 1983, as amended at 53 FR 52394, Dec. 27, 1988]

§ 420.4 Annual State applications.

(a) To be eligible for financial assistance under this part, a State shall submit to the Operations Office Manager an original and two copies of the annual application executed by the Governor. The date for submission of the annual State application shall be set by DOE.

(b) An application shall include with respect to either a plan or supplemental plan or both:

(1) A description of the energy conservation goals to be achieved, including wherever practicable, an estimate of the energy to be saved by implementation of the State plan, why they were selected, how the attainment of the goals will be measured by the State, and how the program measures included in the State plan represent a strategy to achieve these goals.

(2) For the budget period for which financial assistance will be provided:

(i) A total program budget broken out by object class category and by source of funding;

(ii) A narrative statement detailing the nature of amendments and of new program measures;

(iii) For each program measure, a budget and listing of milestones; and

(iv) An explanation of how the minimum criteria for required program measures prescribed in § 420.6 for plans and § 420.7 for supplemental plans shall be satisfied.

(3) A detailed description of the increase or decrease in environmental residuals expected from implementation of either a plan or supplemental plan, or both, defined insofar as possible through the use of information to be provided by DOE, and an indication of how these environmental factors were considered in the selection of program measures.

(4) For program measures involving purchase or installation of materials or equipment for energy conservation or weatherization of low-income housing or schools and hospitals, an explanation of how these measures would supplement and not supplant the two existing DOE programs in these areas.

(c) The Governor may request an extension of the annual submission date by submitting a written request to the Operations Office Manager not less than 15 days prior to the annual submission date. The extension shall be granted only if, in the Operations Office Manager's judgment, acceptable and substantial justification is shown, and the extension would further objectives of the Act.

(Approved by the Office of Management and Budget under control numbers 1904-0026 and 1901-0127)

[48 FR 39360, Aug. 30, 1983, as amended at 53 FR 52395, Dec. 27, 1988]

§ 420.5 Review and approval of annual State applications and State plans.

(a) After receipt of an application for financial assistance or for approval of an amendment to a State plan, the Operations Office Manager may request the State to submit within a reasonable period of time any revisions necessary to make the application complete to bring the application into compliance with the requirements of this part. The Operations Office Manager shall attempt to resolve any dispute over the application informally and to seek voluntary compliance. If a State fails to submit timely appropriate revisions to complete an application, the Operations Office Manager may reject the application as incomplete in a written decision, including a statement of reasons, which shall be subject to administrative review under § 420.9 of this part.

(b) On or before 60 days from the date that a timely filed application is complete, the Operations Office Manager shall decide whether DOE shall approve the application. The Operations Office Manager may—

(1) Approve the application in whole or in part to the extent that—

(i) The application conforms to the requirements of this part;

(ii) The proposed program measures are consistent with a State's achievement of its energy conservation goals in accordance with § 420.4; and

(iii) The provisions of the application regarding program measures satisfy the minimum requirements prescribed by § 420.6 and § 420.7 as applicable;

(2) Approve the application in whole or in part subject to special conditions designed to ensure compliance with the requirements of this part; or

(3) Disapprove the application if it does not conform to the requirements of this part.

[55 FR 41324, Oct. 10, 1990]

§ 420.6 Minimum criteria for required program measures for plans.

A plan shall satisfy all of the following minimum criteria for required program measures.

(a) Mandatory lighting efficiency standards for public buildings shall:

(1) Be implemented throughout the State, except that the standards shall be adopted by the State as a model code for those local governments of the State for which the State's constitution reserves the exclusive authority to adopt and implement building standards within their jurisdictions;

(2) Apply to all public buildings above a certain size, as determined by the State;

(3) For new public buildings, be no less stringent than provisions of Section 9 of ASHRAE 90-75; and

(4) For existing public buildings, contain the elements deemed appropriate by the State.

(b) Program measures to promote the availability and use of carpools, vanpools, and public transportation shall:

(1) Have at least one of the following actions under implementation in at

least one urbanized area with a population of 50,000 or more within the State or in the largest urbanized area within the State if that State does not have an urbanized area with a population of 50,000 or more:

(i) A carpool/vanpool matching and promotion campaign;

(ii) Park-and-ride lots;

(iii) Preferential traffic control for carpoolers and public transportation patrons;

(iv) Preferential parking for carpools and vanpools;

(v) Variable working schedules;

(vi) Improvement in transit level of service for public transportation;

(vii) Exemption of carpools and vanpools from regulated carrier status;

(viii) Parking taxes, parking fee regulations or surcharge on parking costs;

(ix) Full-cost parking fees for State and/or local government employees;

(x) Urban area traffic restrictions;

(xi) Geographical or time restrictions on automobile use; or

(xii) Area or facility tolls; and

(2) Be coordinated with the relevant Metropolitan Planning Organization, unless no Metropolitan Planning Organization exists in the urbanized area, and not be inconsistent with any applicable Federal requirements.

(c) Mandatory standards and policies affecting the procurement practices of the State and its political subdivisions to improve energy efficiency shall—

(1) With respect to all State procurement and with respect to procurement of political subdivisions to the extent determined feasible by the State, be under implementation; and

(2) Contain the elements deemed appropriate by the State to improve energy efficiency through the procurement practices of the State and its political subdivisions.

(d) Mandatory thermal efficiency standards for new and renovated buildings shall—

(1) Be implemented throughout the State, with respect to all buildings other than exempted buildings, except that the standards shall be adopted by the State as a model code for those local governments of the State for which the State's constitution reserves the exclusive authority to adopt and implement building standards within their jurisdictions;

(2) Take into account the exterior envelope physical characteristics, HVAC system selection and configuration, HVAC equipment performance and service water heating design and equipment selection;

(3) For all new commercial buildings, be no less stringent than a standard consistent with provisions of Sections 4-9 of ASHRAE 90-75, unless the operation of section 327 of the Energy Policy and Conservation Act, as amended, 42 U.S.C. 6297, renders reliance on such standard to be impracticable;

(4) For all new residential buildings, be no less stringent than either the HUD minimum property standards or a standard consistent with the provisions of Sections 4-9 of ASHRAE 90-75, unless the operation of Section 327 of the Energy Policy and Conservation Act, as amended, 42 U.S.C. 6297, renders reliance on such standards to be impracticable; and

(5) For renovated buildings:

(i) Apply to those buildings determined by the State to be renovated buildings; and

(ii) Contain the elements deemed appropriate by the State regarding thermal efficiency standards for renovated buildings.

(e) A traffic law or regulation which permits the operator of a motor vehicle to make a right turn at a red light after stopping shall:

(1) Be in a State's motor vehicle code and under implementation throughout all political subdivisions of the State, except as provided in paragraph (e)(3) of this section;

(2) Permit the operator of a motor vehicle to make a right turn (left turn with respect to the Virgin Islands) at a red traffic light after stopping except where specifically prohibited by a traffic sign for reasons of safety or except where generally prohibited in an urban enclave for reasons of safety; and

(3) For any State without such traffic law or regulation in effect before December 31, 1978, be ready for implementation by June 27, 1979, and fully meet the requirements of paragraphs

(e)(1) and (2) of this section thereafter.

§ 420.7 Minimum criteria for required program measures for supplemental plans.

A supplemental plan shall satisfy all of the following minimum criteria for required measures.

(a) Procedures for carrying out a continuing public education effort to increase significantly public awareness of the energy and cost savings which are likely to result from the implementation, including implementation through group efforts, of energy measures shall:

(1) Be under implementation; and

(2) Provide a public awareness program regarding energy audits with respect to buildings and industrial plants which at least includes a campaign publicizing the availability of energy audits in at least one urbanized area with a population greater than 50,000 or in the largest urbanized area within a State if the State does not have an urbanized area with a population of 50,000 or more. The campaign must make clear reference to the range of technical assistance available to the owner or occupant of the building or industrial plant and provide a point of contact with the organization administering the energy audits, including a telephone number;

(b) Procedures for carrying out a continuing public education effort to increase significantly public awareness of information and other assistance, including information as to available technical assistance, which is or may be available with respect to the planning, financing, installing, and monitoring the effectiveness of measures likely to conserve, or to improve efficiency in the use of energy, including energy measures shall:

(1) Be in place and under implementation; and

(2) Contain the elements considered appropriate by a State.

(c) Procedures for ensuring that effective coordination exists among various local, State and Federal energy conservation programs within and affecting such State, including the comprehensive energy extension service program, under 10 CFR Part 465, shall:

(1) Be in place and under implementation; and

(2) Contain provisions for activities considered appropriate by a State such as coordinating local and State agencies to prevent duplication of energy conservation activities or conducting public hearings to ensure that individuals and groups concerned with program measures to be incorporated in a plan or supplemental plan and all other energy conservation programs in the State, shall be afforded the opportunity to paricipate in their development, implementation, and modification.

(d) Procedures for encouraging and for carrying out energy audits with respect to buildings and industrial plants shall:

(1) Be under implementation throughout all political subdivisions of the State;

(2) Be in accordance with Subpart B of the 10 CFR Part 450; and

(3) Provide and make available, to the extent feasible, Class A energy audits in at least one political subdivision for the buildings or industrial plants in at least one of the following categories and as many Class C energy audits as are practicable within the State in the remaining categories:

(i) Apartment buildings;

(ii) Educational institutions;

(iii) Hospitals;

(iv) Hotels and motels;

(v) Industrial plants;

(vi) Office buildings;

(vii) Restaurants;

(viii) Retail stores;

(ix) Transportation terminals; and

(x) Warehouses and storage facilities; and

(4) Make available Class B or C audits to all individuals, as requested by such individuals, who are occupants of residential dwelling units in a State at no direct cost to those persons.

§ 420.8 Extensions for compliance with required program measures.

An extension of time by which a required program measure must be ready for implementation may be granted if DOE determines that the extension is justified. A written request for an extension, with accompanying justification and an action plan acceptable to DOE for achieving compliance in the shortest reasonable time, shall be made to the appropriate Operations Office Manager. Any extension shall be only for the shortest reasonable time that DOE determines necessary to achieve compliance. The action plan shall contain a schedule for full compliance and shall identify and make the most reasonable commitment possible to provision of the resources necessary for achieving the scheduled compliance.

§ 420.9 Administrative review.

(a) An applicant shall have 20 days from the date of receipt of a decision under § 420.5 to file a notice requesting administrative review in accordance with paragraph (b) of this section. If an applicant does not timely file such a notice, the decision under § 420.5 shall become final for DOE.

(b) A notice requesting administrative review shall be filed with the Operations Office Manager and shall be accompanied by a written statement containing supporting arguments. If the Operations Office Manager has disapproved an entire application for financial assistance, the State may request a public hearing.

(c) A notice or any other document shall be deemed filed under this section upon receipt.

(d) On or before 15 days from receipt of a notice requesting administrative review which is timely filed, the Operations Office Manager shall forward to the Deputy Assistant Secretary, the notice requesting administrative review, the decision under § 420.5 as to which administrative review is sought, a draft recommended final decision for concurrence, and any other relevant material.

(e) If the State requests a public hearing on the disapproval of an entire application for financial assistance, the Deputy Assistant Secretary, within 15 days, shall give actual notice to the State and FEDERAL REGISTER notice of the date, place, time, and procedures which shall apply to the public hearing. Any public hearing under this section shall be informal and legislative in nature.

(f) On or before 45 days from receipt of documents under paragraph (d) of this section or the conclusion of the public hearing, whichever is later, the Deputy Assistant Secretary shall concur in, concur in as modified, or issue a substitute for the recommended decision of the Operations Office Manager.

(9) On or before 15 days from the date of receipt of the determination under paragraph (f) of this section, the Governor may file an application for discretionary review by the Assistant Secretary. On or before 15 days from filing, the Assistant Secretary shall send a notice to the Governor stating whether the Deputy Assistant Secretary's determination will be reviewed. If the Assistant Secretary grants a review, a decision shall be issued no later than 60 days from the date review is granted. The Assistant Secretary may not issue a notice or decision under this paragraph without the concurrence of the DOE Office of General Counsel.

(h) A decision under paragraph (f) of this section shall be final for DOE if there is no review under paragraph (g) of this section. If there is review under paragraph (g) of this section, the decision thereunder shall be final for DOE and no appeal shall lie elsewhere in DOE.

(i) Prior to the effective date of the termination or suspension of a grant award for failure to implement an approved State plan in compliance with the requirements of this part, a grantee shall have the right to written notice of the basis for the enforcement action and of the opportrunity for public hearing before the DOE Financial Assistance Appeals Board notwithstanding any provisions to the contrary of 10 CFR 600.26, 600.28(b), 600.29, 600.121(c), and 600.443. To obtain a public hearing, the grantee must request an evidentiary hearing, with prior Federal Register notice, in the election letter submitted under Rule 2 of 10 CFR 1024.4 and the request shall be granted notwithstanding any provisions to the contrary of Rule 2.

[55 FR 41325, Oct. 10, 1990]

§ 420.10 Technical assistance.

At the request of the Governor of any State to DOE and subject to the availability of personnel and funds, DOE will provide information and technical assistance to the State in connection with effectuating the purposes of this part.

§ 420.11 Reports.

Each State receiving financial assistance under this part shall submit to the Operations Office Manager:

(a) A quarterly program performance report and a quarterly financial status report. The reports shall contain such information as the Secretary may prescribe in order to monitor effectively the implementation of a plan or supplemental plan. The reports shall be submitted within 30 days following the end of each calendar year quarter.

(b) An annual energy savings report. The report shall contain such information concerning energy savings as the Secretary may prescribe and shall be submitted once a year at a time determined by the Secretary.

(Approved by the Office of Management and Budget under control numbers 1904-0026 and 1901-0127)

§ 420.12 Prohibited expenditures.

(a) No financial assistance provided to a State under this part shall be used:

(1) For construction, such as construction of mass transit systems and exclusive bus lanes, or for construction or repair of buildings or structures;

(2) To purchase land, a building or structure or any interest therein;

(3) To subsidize fares for public transportation;

(4) To subsidize utility rate demonstrations or State tax credits for energy conservation; or

(5) To conduct or purchase equipment to conduct research, development or demonstration of conservation techniques and technologies not commercially available.

(b) No more than 20 percent of the financial assistance awarded to the State for this program shall be used to purchase office supplies, library materials, or other equipment whose purchase is not otherwise prohibited by this section. Nothing in this paragraph shall be read to apply this 20 percent limitation to petroleum violation to escrow funds used under this part.

(c) Demonstrations of commercially available conservation techniques and technologies are permitted, and are not subject to the prohibitions of § 420.12(a) (1) and (6), or to the limitation on equipment purchases of § 420.12(b).

(d) A State may use regular or revolving loan mechanisms to fund SECP services which are consistent with this part and which are included in the State's approved SECP plan. The State may use loan repayments and any interest on the loan funds only for activities which are consistent with this Part and which are included in the State's approved SECP plan.

(e) A State may use funds under this part to promote the purchase and installation of equipment and materials for energy conservation building retrofits or weatherization, subject to the following terms and conditions:

(1) Such use must be included in the State's approved plan or supplemental plan and, if funded by petroleum violation escrow funds, must be consistent with any judicial or administrative terms and conditions imposed upon State use of such funds;

(2) A State may use for these purposes no more than 33 percent of all funds allocated by the State to SECP in any given year, regardless of source;

(3) Subject to the restrictions of this part, State and local government buildings, as defined in § 420.2, are eligible for energy conservation building retrofits and weatherization under this section;

(4) Funds must be used to supplement and no funds may be used to supplant energy conservation building retrofits or weatherization activities under the Weatherization Assistance Program for Low-Income Persons, 42 U.S.C. 6861 *et seq.*, or the Institutional Conservation Program, 42 U.S.C. 6371 *et seq.*, nor to find operation and maintenance activities in any building which is eligible for assistance under the Institutional Conservation Program;

(5) Subject to paragraph (e)(6) of this section, a State may use a variety

of financial incentives to fund purchases and installation of materials and equipment under this paragraph including, but not limited to, regular loans, revolving loans, loan buy-downs, and rebates;

(6) The following mechanisms are not allowed for funding the purchase and installation of materials and equipment under this paragraph:

(i) Direct purchases of goods and services by a State or contractors or others working for the State;

(ii) Rebates for more than 50 percent of the total cost of purchasing and installing materials and equipment (States shall set appropriate restrictions and limits to insure most efficient use of rebates);

(iii) Grants;

(iv) Loan guarantees; and

(v) Any otherwise allowable funding mechanism if the contract for the purchase and installation of materials and equipment was entered into before December 27, 1988; and

(7) A State may use loan repayments, including any interest, only for activities which are included in the State's approved SECP plan or supplemental plan.

[48 FR 39360, Aug. 30, 1983, as amended at 53 FR 52395, Dec. 27, 1988]

§ 420.13 Administration of financial assistance.

Grants provided under this part shall comply with applicable law including, but without limitation, the requirements of:

(a) Office of Management and Budget Circular A-97, entitled "Rules and Regulations Permitting Federal Agencies to Provide Specialized or Technical Services to State and Local Units of Government under Title III of the Intergovernmental Coordination Act of 1968;"

(b) DOE Financial Assistance Rules (10 CFR Part 600); and

(c) Other procedures which DOE may from time to time prescribe for the administration of financial assistance under this part.

PART 430—ENERGY CONSERVATION PROGRAM FOR CONSUMER PRODUCTS

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Appendix A to Subpart F of Part 430—Compliance Statement.
Appendix B to Subpart F of Part 430—Sampling Plan for Enforcement Testing.

Authority: Energy Policy and Conservation Act, Title III, Part B, as amended by National Energy Conservation Policy Act, Title IV, Part 2, by the National Appliance Energy Conservation Act, and by the National Appliance Energy Conservation Amendments of 1988 (42 U.S.C. 6291-6309).

Source: 42 FR 27898, June 1, 1977, unless otherwise noted.

Subpart A—General Provisions

§ 430.1 Purpose and scope.

This part establishes the regulations for the implementation of Part B of Title III (42 U.S.C. 6291-6309) of the Energy Policy and Conservation Act (Pub. L. 94-163), as amended by Pub. L. 94-385, Pub. L. 100-12, and Pub. L. 100-357, which establishes an energy conservation program for consumer products other than automobiles.

[54 FR 6074, Feb. 7, 1989]

§ 430.2 Definitions.

For purposes of this part, words shall be defined as provided for in section 321 of the Act and as follows—

Act means the Energy Policy and Conservation Act (Pub. L. 94-163), as amended by the National Energy Conservation Policy Act (Pub. L. 95-619) and by the National Appliance Energy Conservation Act (Pub. L. 100-12).

Annual fuel utilization efficiency means the efficiency descriptor for furnaces and boilers, determined using test procedures prescribed under section 323 and based on the assumption that all—

(a) Weatherized warm air furnaces or boilers are located out-of-doors;

(b) Warm air furnaces which are not weatherized are located indoors and all combustion and ventilation air is admitted through grill or ducts from the outdoors and does not communicate with air in the conditioned space;

(c) Boilers which are not weatherized are located within the heated space.

Automatic clothes washer means a class of clothes washer which has a control system which is capable of scheduling a preselected combination of operations, such as regulation of water temperature, regulation of the water fill level, and performance of wash, rinse, drain, and spin functions without the need for user intervention subsequent to the initiation of machine operation. Some models may require user intervention to initiate these different segments of the cycle after the machine has begun operation, but they do not require the user to intervene to regulate the water temperature by adjusting the external water faucet valves.

Ballast efficacy factor means the relative light output divided by the power imput of a fluorescent lamp ballast, as measured under test conditions specified in ANSI Standard C82.2-1984.

Baseboard electric heater means an electric heater which is intended to be recessed in or surface mounted on walls at floor level, which is characterized by long, low physical dimensions, and which transfers heat by natural convection and/or radiation.

Basic model means all units of a given type of covered product (or class thereof) manufactured by one manufacturer and—

(1) With respect to refrigerators and refrigerator-freezers, which have the same primary energy source, which have electrical characteristics that are essentially identical, and which do not have any differing physical or functional characteristics that affect energy consumption.

(2) With respect to freezers, which have the same primary energy source, which have electrical characteristics that are essentially identical, and which do not have any differing physical or functional characteristics that affect energy consumption.

(3) With respect to dishwashers, which have electrical characteristics which are essentially identical and which do not have any differing physical or functional characteristics which affect energy consumption.

(4) With respect to clothes dryers, which have the same primary energy source, which have electrical characteristics that are essentially identical, and which do not have any differing physical or functional characteristics that affect energy consumption.

(5) With respect to water heaters, which have the same primary energy source and which, with the exception of immersed heating elements, do not have any differing electrical, physical, or functional characteristics that affect energy consumption.

(6) With respect to room air conditioners, having essentially identical functional physical and electrical characteristics.

(7) With respect to unvented home heating equipment, having essentially identical functional physical and electrical characteristics.

(8) With respect to television sets, which have identical screen size, which have electrical characteristics that are essentially identical, and which do not have any differing physical or functional characteristics that affect energy consumption.

(9) With respect to kitchen ranges and ovens, whose major cooking components have the same primary energy source, which have electrical characteristics that are essentially identical, and which do not have any differing physical or functional characteristics that affect energy consumption.

(10) With respect to clothes washers, which have the same primary energy source, which have electrical characteristics that are essentially identical, and which do not have any differing physical or functional characteristics that affect energy consumption.

(11) With respect to humidifiers which have the same primary energy source, which have electrical characteristics that are essentially identical, and which do not have any differing physical of functional characteristics that affect energy consumption.

(12) With respect to dehumidifiers, which have electrical characteristics which are essentially identical and which do not have any differing physi-

cal or functional characteristics which affect energy consumption.

(13) With respect to central air conditioners, which have electrical characteristics which are essentially identical and which do not have any differing physical or functional characteristics that affect energy consumption.

(14) With respect to furnaces, having the same primary energy source and essentially identical functional, physical and electrical characteristics.

(15) With respect to vented home heating equipment, having the same primary energy source and essentially identical functional, physical and electrical characteristics.

Batch means a collection of production units of a basic model from which a batch sample is selected.

Batch sample means the collection of units of the same basic model from which test units are selected.

Batch sample size means the number of units in a batch sample.

Batch size means the number of units in a batch.

Btu means British thermal unit, which is the quantity of heat required to raise the temperature of one pound of water one degree Fahrenheit.

Ceiling electric heater means an electric heater which is intended to be recessed in, surface mounted on, or hung from a ceiling, and which transfers heat by radiation and/or convection (either natural or forced).

Central air conditioner means a product, other than a packaged terminal air conditioner, which is powered by single phase electric current, air cooled, rated below 65,000 Btu per hour, not contained within the same cabinet as a furnace, the rated capacity of which is above 225,000 Btu per hour, and is a heat pump or a cooling unit only.

Central system humidifier means a class of humidifier designed to add moisture into the air stream of a heating system.

Clothes washer means a consumer product designed to clean clothes, utilizing a water solution of soap and/or detergent and mechanical agitation or other movement, and must be one of the following classes: automatic clothes washers, semi-automatic clothes washers, and other clothes washers.

Coil family means a group of coils with the same basic design features that affect the heat exchanger performance. These features are the basic configuration, i.e., A-shape, V-shape, slanted or flat top, the heat transfer surfaces on refrigerant and air sides (flat tubes vs. grooved tubes, fin shapes), the tube and fin materials, and the coil circuitry. When a group of coils has all these features in common, it constitutes a "coil family."

Color television set means an electrical device designed to convert incoming broadcast signals into color television pictures and associated sound.

Condenser-evaporator coil combination means a condensing unit made by one manufacturer and one of several evaporator coils, either manufactured by the same manufacturer or another manufacturer, intended to be combined with that particular condensing unit.

Condensing unit means a component of a central air conditioner which is designed to remove the heat absorbed by the refrigerant and to transfer it to the outside environment, and which consists of an outdoor coil, compressor(s), and air moving device.

Consumer product means any article (other than an automobile, as defined in section 501(1) of the Motor Vehicle Information and Cost Savings Act) of a type:

(a) Which in operation consumes, or is designed to consume, energy; and

(b) Which, to any significant extent, is distributed in commerce for personal use or consumption by individuals; without regard to whether such article of such type is in fact distributed in commerce for personal use or consumption by an individual.

Conventional cooking top means a class of kitchen ranges and ovens which is a household cooking appliance consisting of a horizontal surface containing one or more surface units which include either a gas flame or electric resistance heating.

Conventional oven means a class of kitchen ranges and ovens which is a household cooking appliance consisting of one or more compartments intended for the cooking or heating o food by means of either a gas flame or electric resistance heating. It does not include portable or countertop ovens which use electric resistance heating for the cooking or heating of food and are designed for an electrical supply of approximately 120 volts.

Conventional range means a class of kitchen ranges and ovens which is a household cooking appliance consisting of a conventional cooking top and one or more conventional ovens.

Convertible cooking appliance means any kitchen range and oven which is a household cooking appliance designed by the manufacturer to be changed in service from use with natural gas to use with LP-gas, and vice versa, by incorporating in the appliance convertible orifices for the main gas burners and a convertible gas pressure regulator.

Covered product means a consumer product of a type specified in section 322 of the Act.

Dehumidifier means a self-contained, electrically-powered, mechanically-refrigerated device designed primarily to decrease the moisture content of the air in an enclosed space; it has a refrigerated surface (evaporator) onto which moisture from the air condenses, a refrigerating system that includes an electric motor, a fan for circulating air, and a drainage arrangement for collecting and/or disposing of the condensate.

Direct vent system means a system supplied by a manufacturer which provides outdoor air or air from an unheated space (such as an attic or crawl space) directly to a furnace or vented heater for combustion and for draft relief if the unit is equipped with a draft control device.

Dishwasher means a cabinet-like appliance which with the aid of water and detergent, washes, rinses, and dries (when a drying process is included) dishware, glassware, eating utensils, and most cooking utensils by chemical, mechanical and/or electrical means and discharges to the plumbing drainage system.

DOE means the Department of Energy.

Electric boiler means an electrically powered furnace designed to supply low pressure steam or hot water for space heating application. A low pressure steam boiler operates at or below 15 pounds per square inch gauge (psig) steam pressure; a hot water boiler operates at or below 160 psig water pressure and 250° F. water temperature.

Electric central furnace means a furnace designed to supply heat through a system of ducts with air as the heating medium, in which heat is generated by one or more electric resistance heating elements and the heated air is circulated by means of a fan or blower.

Electric clothes dryer means a cabinet-like appliance designed to dry fabrics in a tumble-type drum with forced air circulation. The heat source is electricity and the drum and blower(s) are driven by an electric motor(s).

Electric heater means an electric appliance in which heat is generated from electrical energy and dissipated by convection and radiation and includes baseboard electric heaters, ceiling electric heaters, floor electric heaters, portable electric heaters, and wall electric heaters.

Electric refrigerator means a cabinet designed for the refrigerated storage of food at temperatures above 32° F., and having a source of refrigeration requiring single phase, alternating current electric energy input only. An electric refrigerator may include a compartment for the freezing and storage of food at temperatures below 32° F., but does not provide a separate low temperature compartment designed for the freezing and storage of food at temperatures below 8° F.

Electric refrigerator-freezer means a cabinet which consists of two or more compartments with at least one of the compartments designed for the refrigerated storage of food at temperatures above 32° F. and with at least one of the compartments designed for the freezing and storage of food at temperatures below 8° F. which may be adjusted by the user to a temperature of 0° F. or below. The source of refrigeration requires single phase, alternating current electric energy input only.

Energy conservation standard means:

(a) A performance standard which prescribes a minimum level of level of energy efficiency or a maximum quantity of energy use for a covered product, determined in accordance with test procedures prescribed under section 323; or

(b) A design requirement for the products specified in paragraphs (6), (7), (8), (10), and (13) of section 322(a) of the Act; and includes any other requirements which the Secretary may prescribe under section 325(o) of the Act.

Evaporator coil means a component of a central air conditioner which is designed to absorb heat from an enclosed space and transfer the heat to a refrigerant.

Floor electric heater means an electric heater which is intended to be recessed in a floor, and which transfers by radiation and/or convection (either natural or forced).

Fluorescent lamp ballast means a device which is used to start and operate fluorescent lamps by providing a starting voltage and current and limiting the current during normal operation.

Forced air central furnace means a gas or oil burning furnace designed to supply heat through a system of ducts with air as the heating medium. The heat generated by combustion of gas or oil is transferred to the air within a casing by conduction through heat exchange surfaces and is circulated through the duct system by means of a fan or blower.

Freezer means a cabinet designed as a unit for the freezing and storage of food at temperatures of 0° F. or below, and having a source of refrigeration requiring single phase, alternating current electric energy input only.

Furnace means a product which utilizes only single-phase electric current, or single-phase electric current or DC current in conjunction with natural gas, propane, or home heating oil, and which—

(a) Is designed to be the principal heating sources for the living space of a residence;

(b) Is not contained within the same cabinet with a central air conditioner whose rated cooling capacity is above 65,000 Btu per hour;

(c) Is an electric central furnace, electric boiler, forced-air central furnace, gravity central furnace, or low pressure steam or hot water boiler; and

(d) Has a heat imput rate of less than 300,000 Btu per hour for electric boilers and low pressure steam or hot water boilers and less than 225,000 Btu per hour for forced-air central furnaces, gravity central furnaces, and electric central furnaces, gravity central furnaces, and electric central furnaces.

Gas means either natural gas or propane.

Gas clothes dryer means a cabinet-like appliance designed to dry fabrics in a tumble-type drum with forced air circulation. The heat source is gas and the drum and blower(s) are driven by an electric motor(s).

Gravity central furnace means a gas fueled furnace which depends primarily on natural convection for circulation of heated air and which is designed to be used in conjunction with a system of ducts.

Heat pump means a product, other than a packaged terminal heat pump, which consists of one or more assemblies, powered by single phase electric current, rated below 65,000 Btu per hour, utilizing an indoor conditioning coil, compressor, and refrigerant-to-outdoor air heat exchanger to provide air heating, and may also provide air cooling, dehumidifying, humidifying circulating, and air cleaning.

Home heating equipment, not including furnaces means vented home heating equipment and unvented home heating equipment.

Humidifier means a consumer product designed to add moisture into the conditioned air, and which falls into one of the following classes: a central system humidifier or room humidifier.

Immersed heating element means an electrically powered heating device which is designed to operate while totally immersed in water in such a manner that the heat generated by the device is imparted directly to the water.

Kerosene means No. 1 fuel oil with a viscosity meeting the specifications as specified in UL-730-1974, section 36.9 and in tables 2 and 3 of ANSI Standard Z91.1-1972.

Kitchen ranges and ovens means consumer products that are used as the major household cooking appliances. They are designed to cook or heat different types of food by one or more of the following sources of heat: Gas, electricity, or microwave energy. Each product may consist of a horizontal cooking top containing one or more surface units and/or one or more heating compartments. They must be one of the following classes: Conventional ranges, conventional cooking tops, conventional ovens, microwave ovens, microwave/conventional ranges and other kitchen ranges and ovens.

Low pressure steam or hot water boiler means an electric, gas or oil burning furnace designed to supply low pressure steam or hot water for space heating application. A low pressure steam boiler operates at or below 15 pounds psig steam pressure; a hot water boiler operates at or below 160 psig water pressure and 250° F. water temperature.

LP-gas means liquified petroleum gas, and includes propane, butane, and propane/butane mixtures.

Major cooking component means either a conventional cooking top, a conventional oven or a microwave oven.

Manufacturer means any person who manufactures a consumer product.

Microwave/conventional range means a class of kitchen ranges and ovens which is a household cooking appliance consisting of a microwave oven, a conventional oven, and a conventional cooking top.

Microwave oven means a class of kitchen ranges and ovens which is a household cooking appliance consisting of a compartment designed to cook or heat food by means of microwave energy.

Monochrome television set means an electrical device designed to convert incoming broadcast signals into monochrome television pictures and associated sound.

Natural gas means natural gas as defined by the Federal Power Commission.

Oil means heating oil grade No. 2 as defined in American Society for Testing and Materials (ASTM) D396-71.

Other clothes washer means a class of clothes washer which is not an automatic or semi-automatic clothes washer.

Other kitchen ranges and ovens means any class of kitchen ranges and ovens other than the conventional range, conventional cooking top, conventional oven, microwave oven, and microwave/conventional range classes.

Outdoor furnace or boiler is a furnace or boiler normally intended for installation out-of-doors or in an unheated space (such as an attic or a crawl space).

Packaged terminal air conditioner means a wall sleeve and a separate unencased combination of heating and cooling assemblies specified by the builder and intended for mounting through the wall. It includes a prime source of refrigeration, separable outdoor louvers, forced ventilation, and heating availability energy.

Packaged terminal heat pump means a packaged terminal air conditioner that utilizes reverse cycle refrigeration as its prime heat source and should have supplementary heating availability by builder's choice of energy.

Person includes any individual, corporation, company, association, firm, partnership, society, trust, joint venture or joint stock company, the government, and any agency of the United States or any State or political subdivision thereof.

Pool heater means an appliance designed for heating nonpotable water contained at atmospheric pressure, including heating water in swimming pools, spas, hot tubs and similar applications.

Portable electric heater means an electric heater which is intended to stand unsupported, and can be moved from place to place within a structure. It is connected to electric supply by means of a cord and plug, and transfers heat by radiation and/or convention (either natural or forced).

Primary heater means a heating device that is the principal source of heat for a structure and includes baseboard electric heaters, ceiling electric heaters, and wall electric heaters.

Propane means a hydrocarbon whose chemical composition is predominantly C^3H^8, whether recovered from natural gas or crude oil.

Refrigerator means an electric refrigerator.

Refrigerator-freezer means an electric refrigerator-freezer.

Room air conditioner means a consumer product, other than a "packaged terminal air conditioner," which is powered by a single phase electric current and which is an encased assembly designed as a unit for mounting in a window or through the wall for the purpose of providing delivery of conditioned air to an enclosed space. It includes a prime source of refrigeration and may include a means for ventilating and heating.

Room humidifier means a class of humidifier designed to add moisture directly to the conditioned air without requiring connection to a separate heating or distribution system.

Secretary means the Secretary of the Department of Energy.

Semi-automatic clothes washer means a class of clothes washer that is the same as an automatic clothes washer execpt that user intervention is required to regulate the water temperature by adjusting the external water faucet valves.

State means a State, the District of Columbia, Puerto Rico, or any territory or possession of the United States.

State regulation means a law or regulation of a State or political subdivision thereof.

Supplementary heater means a heating device that provides heat to a space in addition to that which is supplied by a primary heater. Supplementary heaters include portable electric heaters.

Surface unit means either a heating unit mounted in a cooking top, or a heating source and its associated heated area of the cooking top, on which vessels are placed for the cooking or heating of food.

Television set means a color television set or a monochrome television set.

Unvented gas heater means an unvented, self-contained, free-standing, nonrecessed gas-burning appliance which furnishes warm air by gravity or fan circulation.

Unvented home heating equipment means a class of home heating equipment, not including furnaces, used for the purpose of furnishing heat to a space proximate to such heater directly from the heater and without duct connections and includes electric heaters and unvented gas and oil heaters.

Unvented oil heater means an unvented, self-contained, free-standing, nonrecessed oil-burning appliance which furnishes warm air by gravity or fan circulation.

Vented floor furnace means a self-contained vented heater suspended from the floor of the space being heated, taking air for combustion from outside this space. The vented floor furnace supplies heated air circulated by gravity or by a fan directly into the space to be heated through openings in the casing.

Vented home heating equipment or "vented heater" means a class of home heating equipment, not including furnaces, designed to furnish warmed air to the living space of a residence, directly from the device, without duct connections (except that boots not to exceed 10 inches beyond the casing may be permitted) and includes: vented wall furnace, vented floor furnace, and vented room heater.

Vented room heater means a self-contained, free standing, nonrecessed, vented heater for furnishing warmed air to the space in which it is installed. The vented room heater supplies heated air circulated by gravity or by a fan directly into the space to be heated through openings in the casing.

Vented wall furnace means a self-contained vented heater complete with grilles or the equivalent, designed for incorporation in, or permanent attachment to, a wall of a residence and furnishing heated air circulated by gravity or by a fan directly into the space to be heated through openings in the casing.

Wall electric heater means an electric heater (excluding baseboard electric heaters) which is intended to be recessed in or surface mounted on walls, which transfers heat by radiation and/or convection (either natural or forced) and which includes forced convectors, natural convectors, radiant heaters, high wall or valance heaters.

Water heater means a product which utilizes oil, gas, or electricity to heat potable water for use outside the heater upon demand, including—

(a) Storage type units which heat and store water at a thermostatically controlled temperature, including gas storage water heaters with an input of 75,000 Btu per hour or less, oil storage water heaters with an input of 105,000 Btu per hour or less, and electric storage water heaters with an input of 12 kilowatts or less;

(b) Instantaneous type units which heat water but contain no more than one gallon of water per 4,000 Btu per hour of input, including gas instantaneous water heaters with an input of 200,000 Btu per hour or less, oil instantaneous water heaters with an input of 210,000 Btu per hour or less, and electric instantaneous water heaters with an input of 12 kilowatts or less; and

(c) Heat pump type units, with a maximum current rating of 24 amperes at a voltage no greater than 250 volts, which are products designed to transfer thermal energy from one temperature level to a higher temperature level for the purpose of heating water, including all ancillary equipment such as fans, storage tanks, pumps, or controls necessary for the device to perform its function.

Weatherized warm air furnace or boiler means a furnace or boiler designed for installation outdoors, approved for resistance to wind, rain, and snow, and supplied with its own venting system.

[42 FR 27898, June 1, 1977]

EDITORIAL NOTE: For Federal Register citations affecting § 430.2, see the List of CFR Sections Affected in the Finding Aids section of this volume.

Subpart B—Test Procedures

§ 430.21 Purpose and scope.

This subpart contains test procedures required to be prescribed by DOE pursuant to section 323 of the Act.

§ 430.22 Test procedures for measures of energy consumption.

(a) *Refrigerators and refrigerator-freezers.* (1) The estimated annual operating cost for electric refrigerators and electric refrigerator-freezers without an anti-sweat heater switch shall be the product of the following three factors: (i) The representative average-use cycle of 365 cycles per year, (ii) the average per-cycle energy consumption for the standard cycle in kilowatt-hours per cycle, determined according to 6.2 of Appendix A1 of this subpart, and (iii) the representative average unit cost of electricity in dollars per kilowatt-hour as provided by the Secretary, the resulting product then being rounded off to the nearest dollar per year.

(2) The estimated annual operating cost for electric refrigerators and electric refrigerator-freezers with an anti-sweat heater switch shall be the product of the following three factors: (i) The representative average-use cycle of 365 cycles per year, (ii) half the sum of the average per-cycle energy consumption for the standard cycle and the average per-cycle energy consumption for a test cycle type with the anti-sweat heater switch in the position set at the factory just prior to shipping, each in kilowatt-hours per cycle, determined according to 6.2 of Appendix A1 of this subpart, and (iii) the representative average unit cost of electricity in dollars per kilowatt-hour as provided by the Secretary, the resulting product then being rounded off to the nearest dollar per year.

(3) The estimated annual operating cost for any other specified cycle type for electric refrigerators and electric refrigerator-freezers shall be the product of the following three factors: (i) The representative average-use cycle of 365 cycles per year, (ii) the average per-cycle energy consumption for the specified cycle type, determined according to 6.2 of Appendix A1 to this subpart, and (iii) the representative average unit cost of electricity in dollars per kilowatt-hour as provided by the Secretary, the resulting product then being rounded off to the nearest dollar per year.

(4) The energy factor for electric refrigerators and electric refrigerator-freezers, expressed in cubic feet per kilowatt-hour per cycle, shall be—

(i) For electric refrigerators and electric refrigerator-freezers not having an anti-sweat heater switch, the quotient of (A) the adjusted total volume in cubic feet, determined according to 6.1 of Appendix A1 of this subpart, divided by (B) the average per-cycle energy consumption for the standard cycle in kilowatt-hours per cycle, determined according to 6.2 of Appendix A1 of this subpart, the resulting quotient then being rounded off to the second decimal place, and

(ii) For electric refrigerators and electric refrigerator-freezers having an anti-sweat heater switch, the quotient of (A) the adjusted total volume in cubic feet, determined according to 6.1 of Appendix A1 of this subpart, divided by (B) half the sum of the average per-cycle energy consumption for the standard cycle and the average per-cycle energy consumption for a test cycle type with the anti-sweat heater switch in the position set at the factory just prior to shipping, each in kilowatt-hours per cycle, determined according to 6.2 of Appendix A1 of this subpart, the resulting quotient then being rounded off to the second decimal place.

(5) The annual energy use of electric refrigerators and electric refrigerator-freezers equals the representative average use cycle of 365 cycles per year times the average per-cycle energy consumption for the standard cycle in kilowatt-hours per cycle, determined according to 6.2 of Appendix A1 of this subpart.

(6) Other useful measures of energy consumption for electric refrigerators and electric refrigerator-freezers shall be those measures of energy consumption for electric refrigerators and electric refrigerator-freezers which the Secretary determines are likely to assist consumers in making purchasing decisions which are derived from the application of Appendix A1 of this subpart.

(b) *Freezers.* (1) The estimated annual operating cost for freezers without an anti-sweat heater switch shall be the product of the following three factors: (i) The representative average-use cycle of 365 cycles per year, (ii) the average per-cycle energy consumption for the standard cycle in kilowatt-hours per cycle, determined according to 6.2 of Appendix B1 of this subpart, and (iii) the representative average unit cost of electricity in dollars per kilowatt-hour as provided by the Secretary, the resulting product then being rounded off to the nearest dollar per year.

(2) The estimated annual operating cost for freezers with an anti-sweat heater switch shall be the product of the following three factors: (i) The representative average-use cycle of 365 cycles per year, (ii) half the sum of the average per-cycle energy consumption for the standard cycle and the average per-cycle energy consumption for a test cycle type with the anti-sweat heater switch in the position set at the factory just prior to shipping, each in kilowatt-hours per cycle, determined according to 6.2 of Appendix B1 of this subpart, and (iii) the representative average unit cost of electricity in dollars per kilowatt-hour as provided by the Secretary, the resulting product then being rounded off to the nearest dollar per year.

(3) The estimated annual operating cost for an other specified cycle type for freezers shall be the product of the following three factors: (i) The representative average-use cycle of 365 cycles per year, (ii) the average per-cycle energy consumption for the specified cycle type, determined according to 6.2 of Appendix B1 of this subpart and (iii) the representative average unit cost of electricity in dollars per kilowatt-hour as provided by the Secretary, the resulting product then being rounded off to the nearest dollar per year.

(4) The energy factor for freezers, expressed in cubic feet per kilowatt-hour per cycle, shall be—

(i) For freezers not having an anti-sweat heater switch, the quotient of (A) the adjusted net refrigerated volume in cubic feet, determined according to 6.1 of Appendix B1 of this subpart, divided by (B) the average per-cycle energy consumption for the standard cycle in kilowatt-hours per cycle, determined according to or 6.2 of Appendix B1 of this subpart, the resulting quotient then being rounded off to the second decimal place, and

(ii) For freezers having an anti-sweat heater switch, the quotient of (A) the adjusted net refrigerated volume in cubic feet, determined according to 6.1 of Appendix B1 of this subpart, divided by (B) half the sum of the average per-cycle energy consumption for the standard cycle and the average per-cycle energy consumption for a test cycle type with the anti-sweat switch in the position set at the factory just prior to shipping, each in kilowatt-hours per cycle, determined according to or 6.2 of Appendix B1 of this subpart, the resulting quotient then being rounded off to the second decimal place.

(5) The annual energy use of all freezers equals the representative average-use cycle of 365 cycles per year times the average per-cycle energy consumption for the standard cycle in kilowatt-hours per cycle, determined according to 6.2 of Appendix B1 of this subpart.

(6) Other useful measures of energy consumption for freezers shall be those measures of energy consumption for freezers which the Secretary determines are likely to assist consumers in making purchasing decisions and which are derived from the application of Appendix B1 of this subpart.

(c) *Dishwashers.* (1) The estimated annual operating cost for dishwashers not having a truncated normal cycle as defined in 1.5 of Appendix C to this subpart shall be—

(i) When electrically-heated water is used, the product of the following three factors: (A) The representative average-use cycle of 322 cycles per year, (B) the total per-cycle energy consumption for the normal cycle as defined in 1.3 of Appendix C to this subpart in kilowatt-hours per cycle, determined according to 4.4 of Appendix C to this subpart, and (C) the representative average unit cost in dollars per kilowatt-hour as provided by the Secretary, the resulting product then being rounded off to the nearest dollar per year, and

(ii) When gas-heated or oil-heated water is used, the product of: The representative average use cycle of 322 cycles per year times the sum of (A) the product of the per-cycle machine electrical energy consumption for the normal cycle in kilowatt-hours per cycle, determined according to 4.3 of Appendix C to this subpart, times the representative average unit cost in dollars per kilowatt-hours as provided by the Secretary plus (B) the product of the per-cycle water energy consumption for gas-heated or oil-heated water for the normal cycle, in Btu's per cycle, determined according to 4.2 of Appendix C to this subpart, times the representative average unit cost in dollars per Btu for gas or oil, as appropriate, as provided by the Secretary, the resulting product then being rounded off to the nearest dollar per year.

(iii) When cold water (50 °F) is used, the product of the following three factors:

(A) The representative average use cycle of 322 cycles per year times,

(B) The product of the per-cycle machine electrical energy consumption for the normal cycle in kilowatt-hours per cycle, determined according to 4.3 of Appendix C to this subpart, and

(C) The representative average unit cost in dollars per kilowatt-hours as provided by the Secretary, the resulting product then being rounded off to the nearest dollar per year.

(2) The estimated annual operating cost for dishwashers having a truncated normal cycle as defined in 1.5 of Appendix C to this subpart shall be—

(i) When electrically-heated water is used, the product of the following three factors: (A) The representative average use cycle of 322 cycles per year, (B) one-half the sum of (*1*) the total per-cycle energy consumption for the normal cycle as defined in 1.3 of Appendix C to this subpart plus (*2*) the total per-cycle energy consumption for the truncated normal cycle as defined in 1.5 of Appendix C to this subpart, each in kilowatt-hours and determined according to 4.4 of Appendix C to this subpart, and (C) the representative average unit cost in dollars per killowatt-hour as provided by the Secretary, the resulting product then being rounded off to the nearest dollar per year, and

(ii) When gas-heated or oil-heated water is used, the product of: The representative average use cycle of 322 cycles per year times the sum of (A) one-half the product of the per-cycle machine electrical energy consumption for the normal cycle as defined in 1.3 of Appendix C to this subpart, determined according to 4.3 of Appendix C to this subpart, times the representative average unit cost in dollars per kilowatt-hour as provided by the Secretary, plus one-half the product of the per-cycle machine electrical energy consumption for the truncated normal cycle as defined in 1.5 of Appendix C to this subpart, determined according to 4.3 of Appendix C to this subpart, times the representative average unit cost in dollars per kilowatt-hour as provided by the Secretary plus (B) one-half the product of the per-cycle water energy consumption for gas-heated or oil-heated water for the normal cycle as defined in 1.3 of Appendix C to this subpart, in Btu's per cycle, determined according to 4.2 of Appendix C to this subpart, times the representative average unit cost in dollars per Btu for gas or oil, as appropriate, as provided by the Secretary, plus one-half the product of the per-cycle water energy consumption for gas-heated or oil-heated water for the truncated normal cycle as defined in 1.5 of Appendix C to this subpart, in Btu's per cycle, determined according to 4.2 of Appendix C to this subpart, times the representative average unit cost in dollars per Btu for gas or oil, as appropriate, as provided by the Secretary, the resulting product then being rounded off to the nearest dollar per year.

(iii) When cold water (50 °F) is used, the product of the following three factors:

(A) The representative average use cycle of 322 cycles per year,

(B) One-half the sum of (1) the total per-cycle energy consumption for the normal cycle as defined in 1.3 of Appendix C to this subpart plus (2) the truncated normal cycle as defined in 1.5 of Appendix C to this subpart, each in kilowatt-hours and determined according to 4.4 of Appendix C to this subpart, and

(C) The representative average unit cost in dollars per kilowatt-hour as provided by the Secretary, the resulting product then being rounded off to the nearest dollar per year.

(3) The energy factor for dishwashers, expressed in cycles per kilowatt-hour shall be—

(i) For dishwashers not having a truncated normal cycle, as defined in 1.5 of Appendix C to this subpart, capable of being preset, the reciprocal of the total per cycle energy consumption for the normal cycle in kilowatt-hours per cycle, determined according to 4.4 of Appendix C to this subpart, and

(ii) For dishwashers having a truncated normal cycle, as defined in 1.5 of Appendix C to this subpart, capable of being preset, the reciprocal of one-half the sum of (A) the total per-cycle energy consumption for the normal cycle plus (B) the total per-cycle energy consumption for the truncated normal cycle, each in kilowatt-hours per cycle and determined according to 4.4 of Appendix C to this subpart.

(4) Other useful measures of energy consumption for dishwashers shall be those measures of energy consumption for dishwashers which the Secretary determines are likely to assist consumers in making purchasing decisions and which are derived from the application of Appendix C to this subpart.

(d) *Clothes dryers.* (1) The estimated annual operating cost for clothes dryers shall be—

(i) For an electric clothes dryer, the product of the following three factors: (A) The representative average-use cycle of 416 cycles per year, (B) the total per-cycle energy consumption in kilowatt-hours per-cycle, determined according to 4.1 of Appendix D to this subpart, and (C) the representative average unit cost in dollars per kilowatt-hour as provided by the Secretary, the resulting product then being rounded off to the nearest dollar per year, and

(ii) For a gas clothes dryer, the product of the representative average-use cycle of 416 cycles per year times the sum of (A) the product of the gas dryer electric per-cycle energy consumption in kilowatt-hours per cycle, determined according to 4.2 of Appendix D to this subpart, times the representative average unit cost in dollars per kilowatt-hour as provided by the Secretary plus (B) the product of the total gas dryer gas energy consumption per cycle, in Btu's per cycle, determined according to 4.5 of Appendix D of this subpart, times the representative average unit cost in dollars per

Btu as provided by the Secretary, the resulting product then being rounded off to the nearest dollar per year.

(2) The energy factor, expressed in pounds of clothes per kilowatt-hour, for clothes dryers shall be either the quotient of a 3-pound bone-dry test load for compact dryers, as defined by 2.6.1 of Appendix D to this subpart or the quotient of a 7 pound bone-dry test load for standard dryers, as defined by 2.6.2 of Appendix D to this subpart, as applicable, divided by the clothes dryer energy consumption per cycle, as determined according to 4.1 for electric clothes dryers and 4.6 for gas clothes dryers of Appendix D to this subpart, the resulting quotient then being rounded off to the nearest hundredth (.01).

(3) Other useful measures of energy consumption for clothes dryers shall be those measures of energy consumption for clothes dryers which the Secretary determines are likely to assist consumers in making purchasing decisions and which are derived from the application of Appendix D to this subpart.

(e) *Water Heaters.* (1) The estimated annual operating cost for water heaters shall be—

(i) For a gas or oil water heater, the product of the annual energy consumption, determined according to section 6.1.8 or 6.2.5 of appendix E of this subpart, times the representative average unit cost of gas or oil, as appropriate, in dollars per Btu as provided by the Secretary, the resulting product then being rounded off to the nearest dollar per year.

(ii) For an electric water heater, the product of the annual energy consumption, determined according to section 6.1.8 or 6.2.5 of appendix E of this subpart, times the representative average unit cost of electricity in dollars per kilowatt-hour as provided by the Secretary, divided by 3412 Btu per kilowatt-hour, the resulting quotient then being rounded off to the nearest dollar per year.

(2) The energy factor for the water heaters shall be—

(i) For a gas or oil water heater, as determined by section 6.1.7 or 6.2.4 of appendix E of this subpart rounded off to the nearest 0.01.

(ii) For an electric water heater, as determined by section 6.1.7 or 6.2.4 of appendix E of this subpart rounded off to the nearest 0.01.

(3) Other useful measures of energy consumption for water heaters shall be those measures of energy consumption for water heaters which the Secretary determines are likely to assist consumers in making purchasing decisions and which are derived from the application of Appendix E of this subpart.

(4) The alternative uniform test method for measuring the energy consumption of untested water heaters shall be that set forth in section 7.0 of appendix E of this subpart.

(f) *Room air conditioners.* (1) The estimated annual operating cost for room air conditioners, expressed in dollars per year, shall be determined by multiplying the following three factors: (i) Electrical input power in kilowatts as determined in accordance with 4.2 of Appendix F to this subpart, (ii) The representative average-use cycle of 750 hours of compressor operation per year, and (iii) A representative average unit cost of electrical energy in dollars per kilowatt-hour as provided by the Secretary, the resulting product then being rounded off to the nearest dollar per year.

(2) The energy efficiency ratio for room air conditioners, expressed in Btu's per watt-hour, shall be the quotient of: (i) The cooling capacity in Btu's per hour as determined in accordance with 4.1 of Appendix F to this subpart divided by: (ii) The electrical input power in watts as determined in accordance with 4.2 of Appendix F to this subpart the resulting quotient then being rounded off to the nearest 0.1 Btu per watt-hour.

(3) The average annual energy consumption for room air conditioners, expressed in kilowatt-hours per year, shall be determined by multiplying together the following two factors: (i) Electrical input power in kilowatts as determined in accordance with 4.2 of Appendix F to this subpart, and (ii) A representative average use cycle of 750 hours of compressor operation per year, the resulting product then being rounded off to the nearest kilowatt-hour per year.

(4) Other useful measures of energy consumption for room air conditioners shall be those measures of energy consumption which the Secretary determines are likely to assist consumers in making purchasing decisions and which are derived from the application of Appendix F to this subpart.

(g) *Unvented home heating equipment.* (1) The estimated annual operating cost for primary electric heaters, shall be the product of: (i) The average annual electric energy consumption in kilowatt-hours per year, determined according to section 3.1 of Appendix G of this subpart and (ii) the representative average unit cost in dollars per kilowatt-hour as provided pursuant to section 323(b)(2) of the Act, the resulting product then being rounded off to the nearest dollar per year.

(2) The estimated regional annual operating cost for primary electric heaters, shall be the product of: (i) The regional annual electric energy consumption in kilowatt-hours per year for primary heaters determined according to section 3.2 of Appendix G of this subpart and (ii) the representative average unit cost in dollars per kilowatt-hour as provided pursuant to section 323(b)(2) of the Act, the resulting product then being rounded off to the nearest dollar per year.

(3) The estimated operating cost per million Btu output shall be—

(i) For primary and supplementary electric heaters and unvented gas and oil heaters without an auxiliary electric system, the product of: (A) One million; and (B) the representative unit cost in dollars per Btu for natural gas, propane, or oil, as provided pursuant to section 323(b)(2) of the Act as appropriate, or the quotient of the representative unit cost in dollars per kilowatt-hour, as provided pursuant to section 323(b)(2) of the Act, divided by 3,412 Btu per kilowatt hour, the resulting product then being rounded off to the nearest 0.01 dollar per million Btu output; and

(ii) For unvented gas and oil heaters with an auxiliary electric system, the product of: (A) The quotient of one million divided by the rated output in Btu's per hour as determined in 3.4 of appendix G of this subpart; and (B) the sum of: (*1*) The product of the maximum fuel input in Btu's per hour as determined in 2.2. of this appendix times the representative unit cost in dollars per Btu for natural gas, propane, or oil, as appropriate, as provided pursuant to section 323(b)(2) of the Act, plus (*2*) the product of the maximum auxiliary electric power in kilowatts as determined in 2.1 of appendix G of this subpart times the representative unit cost in dollars per kilowatt-hour as provided pursuant to section 323(b)(2) of the Act, the resulting quantity shall be rounded off to the nearest 0.01 dollar per million Btu output.

(4) The rated output for unvented heaters is the rated output as determined according to either sections 3.3 or 3.4 of Appendix G of this subpart, as appropriate, with the result being rounded to the nearest 100 Btu per hour.

(5) Other useful measures of energy consumption for unvented home heating equipment shall be those measures of energy consumption for unvented home heating equipment which the Secretary determines are likely to assist consumers in making purchasing decisions and which are derived from the application of Appendix G of this subpart.

(h) *Television sets.* (1) The estimated average annual operating cost for television sets shall be the product of:

(i) The average annual energy consumed by the television set in kilowatt-hours per year, determined according to 3.0 of Appendix H of this subpart, and

(ii) The representative average unit cost of energy in dollars per kilowatt-hour as provided by the Secretary, the resulting product then being rounded off to the nearest dollar per year.

(2) The receiver energy efficiency factor for television sets shall be:

(i) For color television sets, the product of the estimated minimum power requirement (.130 kilowatts) and the average annual hours of use (2,200 hr/yr.), divided by the average annual energy consumed by the television set in kilowatt-hours per year, determined according to 3.0 of Appendix H to this subpart. The resultant is then multiplied by 100 and expressed as a percent.

(ii) For monochrome television sets, the product of the estimated minimum power requirement (.040 kilowatts) and the average annual hours of use (2,200 hr/yr.), divided by the average annual energy consumed by the television set in kilowatt-hours per year determined according to 3.0 of Appendix H of this subpart. The result is then multiplied by 100 and expressed as a percent.

(3) Other useful measures of energy consumption for televison sets shall be those measures of energy consumption for television sets which the Secretary determines are likely to assist consumers in making purchasing decisions and which are derived from the application of Appendix H of this subpart.

(i) *Kitchen ranges and ovens.* (1) The estimated annual operating cost for conventional ranges, conventional cooking tops, conventional ovens, microwave ovens, and microwave/conventional ranges shall be the sum of the following products: (i) The total annual electrical energy consumption for any electrical energy usage, in kilowatt-hours (kWh's) per year, times the representative average unit cost for electricity, in dollars per kWh, as provided pursuant to section 323(b)(2) of the Act; plus (ii) the total annual gas energy consumption for any natural gas usage, in British thermal units (Btu's) per year, times the representative average unit cost for natural gas, in dollars per Btu, as provided pursuant to section 323(b)(2) of the Act; plus (iii) the total annual gas energy consumption for any propane usage, in Btu's per year, times the representative average unit cost for propane, in dollars per Btu, as provided pursuant to section 323(b)(2) of the Act. The total annual energy consumption for conventional ranges, conventional cooking tops, conventional ovens, microwave ovens, and microwave/conventional ranges shall be as determined according to 4.3.1, 4.2.2, 4.1.2.5 or 4.1.2.6, 4.4.3, and 4.5.1.3, respectively, of Appendix I to this subpart. The estimated annual operating cost shall be rounded off to the nearest dollar per year, except for microwave ovens, for which the estimated annual operating cost shall be rounded off to the nearest one-quarter of a dollar per year.

(2) The cooking efficiency for conventional cooking tops, conventional ovens, and microwave ovens shall be the ratio of the cooking energy output for the test to the cooking energy input for the test, as determined according to 4.2.1.3, 4.1.3 and 4.4.2, respectively, of Appendix I to this subpart. The final cooking efficiency values shall be rounded off to three significant digits.

(3) The cooking efficiency for conventional ranges, and microwave/conventional ranges shall be determined according to 4.3.2 and 4.5.2, respectively, of Appendix I to this subpart, which weights the cooking efficiencies of the major cooking components of the range. The final cooking efficiency values shall be rounded off to three significant digits.

(4) The energy factor for conventional ranges, conventional cooking tops, conventional ovens, microwave ovens, and microwave/conventional ranges shall be the ratio of the annual useful cooking energy output to the total annual energy input, as determined according to 4.3.3, 4.2.3, 4.1.4, 4.4.4 and 4.5.3, respectively, of Appendix I to this subpart. The final energy factor values shall be rounded off to three significant digits.

(5) There shall be two estimated annual operating costs, two cooking efficiencies, and two energy factors for convertible cooking appliances—(i) an estimated annual operating cost, a cooking efficiency and an energy factor which represent values for those three measures of energy consumption for the operation of the appliance with natural gas; and (ii) an estimated annual operating cost, a cooking efficiency and an energy factor which represent values for those three measures of energy consumption for the operation of the appliance with LP-gas.

(6) The estimated annual operating cost for convertible cooking appliances which represents natural gas usage, as described in paragraph (i)(5)(i) of this section, shall be determined according to paragraph (i)(1) of this section using the total annual gas energy con-

sumption for natural gas times the representative average unit cost for natural gas.

(7) The estimated annual operating cost for convertible cooking appliances which represents LP-gas usage, as described in paragraph (i)(5)(ii) of this section, shall be determined according to paragraph (i)(1) of this section using the representative average unit cost for propane times the total annual energy consumption of the test gas, either propane or natural gas.

(8) The cooking efficiency for convertible cooking appliances which represents natural gas usage, as described in paragraph (i)(5)(i) of this section, shall be determined according to paragraphs (i)(2) and (i)(3) of this section when the appliance is tested with natural gas.

(9) The cooking efficiency for convertible cooking appliances which represents LP-gas usage, as described in paragraph (i)(5)(ii) of this section, shall be determined according to paragraphs (i)(2) and (i)(3) of this section, when the appliance is tested with either natural gas or propane.

(10) The energy factor for convertible cooking appliances which represents natural gas usage, as described in paragraph (i)(5)(i) of this section, shall be determined according to paragraph (i)(4) of this section when the appliance is tested with natural gas.

(11) The energy factor for convertible cooking appliances which represents LP-gas usage, as described in paragraph (i)(5)(ii) of this section, shall be determined according to paragraph (i)(4) of this section when the appliance is tested with either natural gas or propane.

(12) Other useful measures of energy consumption for conventional ranges, conventional cooking tops, conventional ovens, microwave ovens and microwave/conventional ranges shall be those measures of energy consumption which the Secretary determines are likely to assist consumers in making purchasing decisions and which are derived from the application of Appendix I to this subpart.

(j) *Clothes washers.* (1) The estimated annual operating cost for automatic and semi-automatic clothes washers shall be—

(i) When electrically heated water is used, the product of the following three factors: (A) The representative average-use cycle of 416 cycles per year, (B) the total per-cycle energy consumption for the normal cycle in kilowatt-hours per cycle determined according to 4.6 of Appendix J to this subpart, and (C) the representative average unit cost in dollars per kilowatt-hour as provided by the Secretary, the resulting product then being rounded off to the nearest dollar per year, and

(ii) When gas-heated or oil-heated water is used, the product of: the representative average-use cycle of 416 cycles per year and the sum of both (A) the product of the per-cycle machine electrical energy consumption for the normal cycle in kilowatt-hours per cycle, determined according to 4.4 of Appendix J to this subpart, and the representative average unit cost in dollars per kilowatt-hour as provided by the Secretary and (B) the product of the per-cycle water energy consumption for gas-heated or oil-heated water for the normal cycle, in Btu per cycle, determined according to 4.5 of Appendix J to this subpart, and the representative average unit cost in dollars per Btu for oil or gas, as appropriate, as provided by the Secretary, the resulting product then being rounded off to the nearest dollar per year.

(2) The energy factor for automatic and semi-automatic clothes washers shall be the quotient of the cubic foot capacity of the clothes container as determined in 3.1 of Appendix J to this subpart divided by the clothes washer energy consumption per cycle, expressed as the sum of the machine electrical energy consumption and the maximum normal water energy consumption as determined in 4.4 and 4.3, respectively, of Appendix J to this subpart. The resulting be rounded off to the nearest 0.01 cubic foot per kilowatt-hour.

(3) Other useful measures of energy consumption for automatic or semi-automatic clothes washers shall be those measures of energy consumption which the Secretary determines are likely to assist consumers in making purchasing decisions and which are derived from the application of Appendix J to this subpart.

(k) *Humidifiers.* (1) The estimated annual operating cost for central system humidifiers shall be—

(i) Where heat is supplied by an electric furnace or electric resistance heating, the sum of: (A) The product of the average annual electric furnace or electric resistance heating energy consumption in kilowatt-hours per year, determined according to 4.1 of Appendix K1 of this subpart, and the representative average unit cost in dollars per kilowatt-hour as provided pursuant to section 323(b)(2) of the Act plus (B) the product of the average annual supplementary electrical energy consumption in kilowatt-hours per year, determined according to 4.2 of Appendix K1 of this subpart, and the representative average unit cost in dollars per kilowatt-hour as provided pursuant to section 323(b)(2) of the Act, the resulting sum then being rounded off to the nearest dollar per year, and

(ii) Where heat is supplied by an electric heat pump, the sum of: (A) The product of the average annual electric heat pump energy consumption in kilowatt-hours per year, determined according to 4.3 of Appendix K1 of this subpart, and the representative average unit cost in dollars per kilowatt-hour as provided pursuant to section 323(b)(2) of the Act plus (B) the product of the average annual supplementary electrical energy consumption in kilowatt-hours per year, determined according to 4.2 of Appendix K1 of this subpart, and the representative average unit cost in dollars per kilowatt-hour as provided pursuant to section 323(b)(2) of the Act, the resulting sum then being rounded off to the nearest dollar per year, and

(iii) Where heat is supplied by a gas or oil fired forced air furnace, the sum of: (A) The product of the average annual gas or oil furnace energy consumption in Btu's per year, determined according to 4.4 or 4.5, respectively, of Appendix K1 of this subpart, and the representative average unit cost in dollars per Btu for gas or oil, as appropriate, as provided pursuant to section 323(b)(2) of the Act plus (B) the product of the average annual supplementary electrical energy consumption in kilowatt-hours per year, determined according to 4.2 of Appendix K1 of this subpart, and the representative average unit cost in dollars per kilowatt-hour as provided pursuant to section 323(b)(2) of the Act; the resulting sum then being rounded off to the nearest dollar per year.

(2) The estimated annual operating cost for room humidifiers shall be—

(i) Where heat is supplied by an electric furnace or electric resistance heating, the sum of: (A) The product of the average annual electric furnace or electric resistance heating energy consumption in kilowatt-hours per year, determined according to 4.1 of Appendix K2 of this subpart, and the representative average unit cost in dollars per kilowatt-hour as provided pursuant to section 323(b)(2) of the Act plus (B) the product of the average annual supplementary electrical energy consumption in kilowatt-hours per year, determined according to 4.2 of Appendix K2 of this subpart, and the representative average unit cost in dollars per kilowatt-hour as provided pursuant to section 323(b)(2) of the Act, the resulting sum then being rounded off to the nearest dollar per year, and

(ii) Where heat is supplied by an electric heat pump, the sum of: (A) The product of the average annual electric heat pump energy consumption in kilowatt-hours per year, determined according to 4.3 of Appendix K2 of this subpart, and the representative average unit cost in dollars per kilowatt-hour as provided pursuant to section 323(b)(2) of the Act, plus (B) the product of the average annual supplementary electrical energy consumption in kilowatt-hours per year, determined according to 4.2 of Appendix K2 of this subpart, and the representative average unit cost in dollars per kilowatt-hour as provided pursuant to section 323(b)(2) of the Act, the resulting sum then being rounded off to the nearest dollar per year, and

(iii) Where heat is supplied by a gas or oil fired forced air furnace, gas or oil boiler, or unvented gas heater, the sum of: (A) The product of the average annual gas or oil furnace, gas or oil boiler, or unvented gas heater energy consumption in Btu's per year, determined according to 4.4 or 4.5, respectively, of Appendix K2 of this subpart, and the representative average unit cost in dollars per Btu for gas or oil, as appropriate, as provided pursuant to section 323(b)(2) of the Act plus (B) the product of the average annual supplementary electrical energy consumption in kilowatt-hours per year, determined according to 4.2 of Appendix K2 of this subpart and the representative average unit cost in dollars per kilowatt-hour as provided pursuant to section 323(b)(2) of the Act, the resulting sum then being rounded off to the nearest dollar per year.

(3) The estimated annual operating cost for humidifiers by geographic region shall be—

(i) Where heat is supplied by an electric furnace or electric resistance heating, the product of: (A) The estimated annual operating cost determined according to paragraph (l)(1)(i) of this section for central system humidifiers, or paragraph (l)(2)(i) of this section for room humidifiers and (B) the regional factors for adjusting the humidity loads of the respective regions, determined according to 5 of Appendix K1 or K2 of this subpart, the resulting product then being rounded off to the nearest dollar per year;

(ii) Where heat is supplied by an electric heat pump, the product of: (A) The estimated annual operating cost determined according to paragraph (l)(1)(ii) of this section for central system humidifiers, or paragraph (l)(2)(ii) of this section or room humidifiers and (B) the regional factors for adjusting the humidity loads of respective regions, determined according to 5 of Appendix K1 or K2 of his subpart, the resulting product then being rounded off to the nearest dollar per year; and

(iii) Where heat is supplied by a gas or oil fired forced air furnace, gas or oil boiler, or unvented gas heater, the product of: (A) The estimated annual operating cost determined according to paragraph (l)(1)(iii) of this section for central system humidifiers, or paragraph (l)(2)(iii) of this section for room humidifiers and (B) the regional factor for adjusting the humidity loads of the respective regions, determined according to 5 of Appendix K1 or K2 of this subpart, the resulting product then being rounded off to the nearest dollar per year.

(4) The energy factor for central system humidifiers shall be the quotient of: (i) The hourly rate of energy output of a central system humidifier, in Btu's per hour, as determined according to 4.9 of Appendix K1 of this subpart, divided by (ii) the sum of (A) the humidistat factor, in Btu's per hour, as determined according to 4.10 of Appendix K1 of this subpart; (B) the hourly rate of electrical energy input to the humidifier, in Btu's per hour, as determined according to 4.7 of Appendix K1 of this subpart; (C) the hourly rate of equivalent electrical energy input for bypass humidifiers, in Btu's per hour, as determined according to 4.8 of Appendix K1 of this subpart; and (D) the rate of waste water energy (q_w) in Btu's per hour, as determined in 4.1 of Appendix K1 of this subpart, the resulting quotient then being rounded off to the nearest 0.01.

(5) The energy factor for room humidifiers shall be the quotient of the humidification power of the humidifier, in kilowatts, determined according to 4.6 of Appendix K2 of this subpart divided by the sum of (A) the humidistat factor, in kilowatts, determined according to 4.7 of Appendix K2 of this subpart, and (B) the input power, in kilowatts, as determined according to 3.2 of Appendix K2 of this subpart, the resulting quotient then being rounded off to the nearest 0.01.

(6) Other useful measures of energy consumption for humidifiers shall be those measures of energy consumption for humidifiers which the Secretary of Energy determines are likely to assist consumers in making purchasing decisions and which are derived from the application of Appendices K1 and K2 of this subpart.

(l) *Dehumidifiers.* (1) The estimated annual operating cost for dehumidifiers shall be the product of the following three factors: (i) The representative average-use cycle of 1,300 hours per year, (ii) the hourly energy consumption in kilowatt-hours per hour, determined according to section 4.2 of Appendix L of this subpart, and (iii) the representative average unit cost in dollars per kilowatt-hour as provided pursuant to section 323(b)(2) of the Act, the resulting product then being rounded off to the nearest dollar per year.

(2) The estimated annual operating cost for dehumidifiers by region shall be the product of the following three factors: (i) The regional representative average-use cycle, determined according to section 5 of Appendix L of this subpart, (ii) the hourly energy consumption in kilowatt-hours per hour, determined according to section 4.2 of Appendix L of this subpart, and (iii) the representative average unit cost in dollars per kilowatt-hour as provided pursuant to section 323(b)(2) of the Act, the resulting product then being rounded off to the nearest dollar per year.

(3) The energy factor, E_f, for dehumidifiers, expressed in pints of condensate collected per kWh, shall be the quotient of the weight of condensate collected, in pounds, as determined in American National Standard (ANS) B149.1-1972, divided by the product of the energy consumption, in kilowatt-hours, as determined in section 3.2 of Appendix L, and a conversion factor of 1.04 pounds per pint, the resulting quotient then being rounded off to the nearest 0.01 pints/kWh.

(4) Other useful measures of energy consumption for dehumidifiers shall be those measures of energy consumption for dehumidifiers which the Secretary of Energy determines are likely to assist consumers in making purchasing decisions and which are derived from the application of Appendix L or this subpart.

(m) *Cental Air Conditioners.* (1) The estimated annual operating cost for cooling-only units and air-source heat pumps shall be one of the following:

(i) For cooling-only units or the cooling portion of the estimated annual operating cost for air-source heat pumps which provide both heating and cooling, the product of: (A) The quotient of the cooling capacity, in Btu's per hour, determined from the steady-state wet-coil test (Test A) measured at the highest compressor speed, as described in section 3.1 of Appendix M to this subpart, divided by the seasonal energy efficiency ratio, in Btu's per watt-hour, determined from section 5.1 of Appendix M to this subpart; (B) the representative average use cycle for cooling of 1,000 hours per year; (C) a conversion factor of 0.001 kilowatt per watt; and (D) the representative average unit cost of electricity in dollars per kilowatt-hour as provided pursuant to section 323(b)(2) of the Act, the resulting product then being rounded off to the nearest dollar per year;

(ii) For air-source heat pumps which provide only heating or the heating portion of the estimated annual operating cost for air-source heat pumps which provide both heating and cooling, the product of: (A) The quotient of the standardized design heating requirement, in Btu's per hour, nearest to the capacity measured in the high temperature test, determined in sections 5.2 and 6.2.6 of Appendix M to this subpart, divided by the heating seasonal performance factor, in Btu's per watt-hour, calculated for heating region IV corresponding to the above mentioned standardized design heating requirement determined from section 5.2 of Appendix M to this subpart; (B) the representative average use cycle for heating of 2,080 hours per year; (C) the adjustment factor of 0.77 which serves to adjust the calculated design heating requirement and heating load hours to the actual load experienced by a heating system; (D) a conversion factor of 0.001 kilowatt per watt; and (E) the representative average unit cost of electricity in dollars per kilowatt-hour as provided pursuant to section 323(b)(2) of the Act, the resulting product then being rounded off to the nearest dollar per year; or

(iii) For air-source heat pumps which provide both heating and cooling, the estimated annual operating cost is the sum of the quantity determined in paragraph (m)(1)(i) of this section added to the quantity determined in paragraph (m)(1)(ii) of this section.

(2) The estimated regional annual operating cost for cooling-only units and for air-source heat pumps shall be one of the following:

(i) For cooling-only units or the cooling portion of the estimated regional annual operating cost for air-source heat pumps which provide both heating and cooling, the product of: (A) The quotient of the cooling capacity, in Btu's per hour, determined from the steady-state wet-coil test (Test A) measured at the highest compressor speed, as described in section 3.1 of Appendix M to this subpart, divided by the seasonal energy efficiency ratio, in Btu's per watt-hour, determined from section 5.1 of Appendix M to this subpart; (B) the estimated number of regional cooling load hours per year determined from section 6.1.3 of Appendix M to this subpart; (C) a conversion factor of 0.001 kilowatts per watt; and (D) the representative average unit cost of electricity in dollars per kilowatt-hour as provided pursuant to section 323(b)(2) of the Act, the resulting product then being rounded off to the nearest dollar per year;

(ii) For air-source heat pumps which provide only heating or the heating portion of the estimated regional annual operating cost for air-source heat pumps which provide both heating and cooling, the product of: (A) The quotient of the standardized design heating requirement, in Btu's per hour, nearest to the capacity measured in the high temperature test (Test A), determined in sections 5.2 and 6.2.6 of Appendix M to this subpart, divided by the heating seasonal performance factor, in Btu's per watt-hour, calculated for the appropriate region of interest and corresponding to the above mentioned standardized design heating requirement determined from section 5.2 of Appendix M to this subpart; (B) the estimated number of regional heating load hours per year determined from section 6.2.5 of Appendix M to this subpart; (C) the adjustment factor of 0.77 which serves to adjust the calculated design heating requirement and heating load hours to the actual load experienced by a heating system; (D) a conversion factor of 0.001 kilowatts per watt; and (E) the representative average unit cost of electricity in dollars per kilowatt-hour as provided pursuant to section 323(b)(2) of the Act, the resulting product then being rounded off to the nearest dollar per year; or

(iii) For air-source heat pumps which provide both heating and cooling, the estimated regional annual operating cost is the sum of the quantity determined in paragraph (m)(3)(i) of this section added to the quantity determined in paragraph (m)(3)(ii) of this section.

(3) The measure(s) of efficiency for cooling-only units and air-source heat pumps shall be one or more of the following:

(i) The seasonal energy efficiency ratio for cooling-only units and air-source heat pumps which provide cooling shall be the seasonal energy efficiency ratio, in Btu's per watt-hour, determined according to section 5.1 of Appendix M to this subpart, rounded off to the nearest 0.05.

(ii) The heating seasonal performance factors for air-source heat pumps shall be the heating seasonal performance factors, in Btu's per watt-hour, determined according to section 5.2 of Appendix M to this subpart for each applicable standardized design heating requirement within each climatic region, rounded off to the nearest 0.05.

(iii) The annual performance factors for air-source heat pumps which provide heating and cooling, shall be the annual performance factors, in Btu's per watt-hour, determined according to section 5.3 of Appendix M to this subpart for each standardized design heating requirement within each climatic region, rounded off to the nearest 0.05.

(4) Other useful measures of energy consumption for central air conditioners shall be those measures of energy consumption which the Secretary of Energy determines are likely to assist consumers in making purchasing decisions and which are derived from the application of Appendix M to this subpart.

(5) After September 12, 1988, all measures of energy consumption shall be determined by the test method as set forth in Appendix M to this subpart; or by an alternate rating method set forth in § 430.23(m)(4) as approved by the Assistant Secretary for Conservation and Renewable Energy in accordance with § 430.23(m)(5).

(n) *Furnaces.* (1) The estimated annual operating cost for furnaces is the sum of: (i) The product of the average annual fuel energy consumption, in Btu's per year for gas or oil furnaces or in kilowatt-hours per year for electric furnaces, determined according to section 4.8 or 4.10 of Appendix N of this subpart, respectively, and the representative average unit cost in dollars per Btu for gas or oil, or dollars per kilowatt-hour for electric, as appropriate, as provided pursuant to section 323(b)(2) of the Act, plus (ii) the product of the average annual auxiliary electric energy consumption in kilowatt-hours per year determined according to section 4.9 of Appendix N of this subpart, and the representative average unit cost in dollars per kilowatt-hour as provided pursuant to section 323(b)(2) of the Act, the resulting sum then being rounded off to the nearest dollar per year. (For furnaces which operate with variable inputs, an estimated annual operating cost is to be calculated for each degree of oversizing specified in section 4 of Appendix N of this subpart.)

(2) The annual fuel utilization efficiency for furnaces, expressed in percent, is the ratio of annual fuel output of useful energy delivered to the heated space to the annual fuel energy input to the furnace determined according to section 4.6 of Appendix N of this subpart for gas and oil furnaces and determined in accordance with section 4.1 of Appendix N of this subpart for electric furnaces.

(3) The estimated regional annual operating cost for furnaces is the sum of: (i) The product of the regional annual fuel energy consumption in Btu's per year for gas or oil furnaces or in kilowatt-hours per year for electric furnaces, determined according to section 4.11 or 4.13 of Appendix N of this subpart, respectively, and the representative average unit cost in dollars per Btu for gas or oil, or dollars per kilowatt-hour for electric, as appropriate, as provided pursuant to section 323(b)(2) of the Act, plus (ii) the product of the regional annual auxiliary electrical energy consumption in kilowatt-hours per year, determined according to section 4.12 of Appendix N of this subpart, and the representative average unit cost in dollars per kilowatt-hour as provided pursuant to section 323(b)(2) of the Act, the resulting sum then being rounded off to the nearest dollar per year.

(4) The energy factor for furnaces, expressed in percent, is the ratio of annual fuel output of useful energy delivered to the heated space to the total annual energy input to the furnace determined according to section 4.14 of Appendix N of this subpart.

(5) Other useful measures of energy consumption for furnaces shall be those measures of energy consumption which the Secretary determines are likely to assist consumers in making purchasing decisions and which are derived from the application of Appendix N of this subpart.

(o) *Vented home heating equipment.*

(1) The annual fuel utilization efficiency for vented home heating equipment, expressed in percent, which is the ratio of the annual fuel output of useful energy delivered to the heated space to the annual fuel energy input to the vented heater, shall be determined either according to section 4.1.17 of Appendix O of this subpart for vented heaters without either manual controls or thermal stack dampers; according to section 4.2.6 of Appendix O of this subpart for vented heaters equipped with manual controls; or according to section 4.3.7 of Appendix O of this subpart for vented heaters equipped with thermal stack dampers.

(2) The estimated operating cost per million Btu output for vented heaters without an auxiliary electric system shall be the product of: (i) One hundred; (ii) the quotient of one million Btu output divided by the annual fuel utilization efficiency as determined in paragraph (o) (1) and (iii) the representative unit cost in dollars per Btu for natural gas, propane, or oil, as appropriate, as provided pursuant to section 323(b)(2) of the Act, the resulting product shall be rounded to the nearest 0.01 dollar per million Btu output.

(3) The estimated operating cost per million Btu output for gas or oil vented home heating equipment with an auxiliary electric system shall be the product of: (A) The quotient of one million Btu divided by the sum of: (*1*) The product of the maximum fuel input in Btu's per hour as determined in 3.1.1 or 3.1.2 of Appendix 0 of this subpart times the annual fuel utilization efficiency in percent as deter-

mined in 4.1.17, 4.2.6, or 4.3.7 of this appendix as appropriate divided by 100, plus (*2*) the product of the maximum electric power in watts as determined in 3.1.3 of Appendix O of this subpart times the quantity 3.412; and (B) of the sum of: (*1*) the product of the maximum fuel input in Btu's per hour as determined in 3.1.1 of this appendix times the representative unit cost in dollars per Btu for natural gas, propane, or oil, as appropriate, as provided pursuant to section 323(b)(2) of the Act; plus (*2*) the product of the maximum auxiliary electric power in kilowatts as determined in 3.1.3 of Appendix O of this subpart times the representative unit cost in dollars per kilowatt-hour as provided pursuant to section 323(b)(2) of the Act, the resulting quantity shall be rounded off to the nearest 0.01 dollar per million Btu output.

(4) Other useful measures of energy consumption for vented home heating equipment shall be those measures of energy consumption which the Secretary determines are likely to assist consumers in making purchasing decisions and which are derived from the application of Appendix O of this subpart.

(p) *Pool heaters.* (1) The estimated annual operating cost (space reserved).

(2) The thermal efficiency of pool heaters, expressed as a percent, shall be determined in accordance with section 4 of Appendix P to this subpart.

(q) *Fluorescent lamp ballasts.* [Reserved]

[42 FR 27898, June 1, 1977, as amended at 42 FR 39967, Aug. 8, 1977; 42 FR 49807, Sept. 28, 1977; 42 FR 54116, Oct. 4, 1977; 42 FR 55603, 55610, Oct. 18, 1977; 43 FR 20119, May 10, 1978; 43 FR 48986, Oct. 19, 1978; 47 FR 34524, Aug. 10, 1982; 48 FR 9206, Mar. 3, 1983; 49 FR 12156, Mar. 28, 1984; 52 FR 47550, Dec. 15, 1987; 53 FR 8311, Mar. 14, 1988; 54 FR 6075, Feb. 7, 1989; 55 FR 42169, Oct. 17, 1990]

EFFECTIVE DATE NOTE: At 55 FR 42169, Oct. 17, 1990, § 430.22 was amended by revising paragraph (e)(1) and (2) and adding paragraph (e)(4), effective April 15, 1991. For the convenience of the user, the superseded text appears below

§ 430.22 Test procedures for measures of energy consumption.

* * * * *

(e) *Water heaters.* (1) The estimated annual operating cost for water heaters shall be—

(i) For a gas or oil water heater, the product of the representative average use cycle of 365 days per year times the sum of (A) The product of the average daily auxiliary electrical energy consumption in kilowatt-hours per day, determined according to section 4.5.1 of Appendix E of this subpart, times the representative average unit cost of electricty in dollars per kilowatt-hour as provided by the Secretary plus (B) The product of the average daily gas or oil energy consumption in Btu per day, determined according to section 4.5.2 of Appendix E of this subpart, times the representative average unit cost of gas or oil, as appropriate, in dollars per Btu as provided by the Secretary, the resulting product then being rounded off to the nearest dollar per year.

(ii) For an electric water heater, the product of the following three factors: (A) The representative average use cycle of 365 days per year, (B) The average daily energy consumption in kilowatt-hours per day, determined according to section 4.5.4 of Appendix E of this subpart, and (C) The representative Average unit cost of electricity in dollars per kilowatt-hour as provided by the Secretary, the resulting product then being rounded off to the nearest dollar per year.

(2) The energy factor for water heaters shall be—

(i) For a gas or oil water heater, the quotient of the daily hot water energy consumption determined according to section 4.6 of Appendix E of this subpart divided by the average daily energy consumption as determined according to section 4.5.3 of Appendix E of this subpart, the resulting quotient then being rounded off to the nearest 0.01; and

(ii) For an electric water heater, the quotient of the daily hot water energy consumption determined according to section 4.6 of Appendix E of this subpart divided by the product of the average daily energy consumption as determined according to section 4.5.4 of Appendix E of this subpart times 3,412 Btu per kilowatt-hour, the resulting quotient then being rounded off to the nearest 0.01.

* * * * *

§ 430.23 Units to be tested.

When testing of a covered product is required to comply with section 323(c) of the Act, or to comply with rules prescribed under sections 324 or 325 of the Act, a sample shall be selected and tested comprised of units which are production units, or are representative of production units of the basic model being tested, and shall meet the following applicable criteria.

(a)(1) For each basic model [1] of electric refrigerators and electric refrigerator-freezers, a sample of sufficient size shall be tested to insure that—

(i) Any represented value of estimated annual operating cost, energy consumption or other measure of energy consumption of a basic model for which consumers would favor lower values shall be no less than the higher of (A) the mean of the sample or (B) the upper 95 percent confidence limit of the true mean divided by 1.10, and

(ii) Any represented value of the energy factor or other measure of energy consumption of a basic model for which consumer would favor higher values shall be no greater than the lower of (A) the mean of the sample or (B) the lower 95 percent confidence limit of the true mean divided by .90.

(b)(1) For each basic model [1] of freezers, a sample of sufficient size shall be tested to insure that—

(i) Any represented value of estimated annual operating cost, energy consumption or other measure of energy consumption of a basic model for which consumers would favor lower values shall be no less than the higher of (A) the mean of the sample or (B) the upper 95 percent confidence limit of the true mean divided by 1.10, and

(ii) Any represented value of the energy factor or other measure of energy consumption of a basic model for which consumers would favor higher values shall be no greater than the lower of (A) the mean of the sample or (B) the lower 95 percent confidence limit of the true mean divided by .90.

(c)(1) For each basic model [1] of dishwashers, a sample of sufficient size shall be tested to insure that—

(i) Any represented value of estimated annual operating cost, energy consumption or other measure of energy consumption of a basic model for which consumers would favor lower values shall be no less than the higher of (A) the mean of the sample or (B) the upper 97½ percent confidence limit of the true mean divided by 1.05, and

(ii) Any represented value of the energy factor or other measure of energy consumption of a basic model for which consumers would favor higher values shall be no greater than the lower of (A) the mean of the sample or (B) the lower 97½ percent confidence limit of the true mean divided by .95.

(d)(1) For each basic model [1] of clothes dryers a sample of sufficient size shall be tested to insure that—

(i) Any represented value of estimated annual operating cost, energy consumption or other measure of energy consumption of a basic model for which consumers would favor lower values shall be no less than the higher of (A) the mean of the sample or (B) the upper 97½ percent confidence limit of the true mean divided by 1.05, and

(ii) Any represented value of the energy factor or other measure of energy consumption of a basic model for which consumers would favor higher values shall be no greater than the lower of (A) the mean of the sample or (B) the lower 97½ percent confidence limit of the true mean divided by .95.

(e)(1) For each basic model [1] of water heaters, a sample of sufficient size shall be tested to insure that—

(i) Any represented value of estimated annual operating cost, energy consumption or other measure of energy consumption of a basic model for which consumers would favor lower values shall be no less than the higher of (A) the mean of the sample or (B) the upper 95 percent confidence limit of the true mean divided by 1.10, and

(ii) Any represented value of the energy factor or other measure of energy consumption of a basic model for which consumers would favor higher values shall be no greater than the lower of (A) the mean of the sample or (B) the lower 95 percent confidence limit of the true mean divided by .90.

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[1] Components of similar design may be substituted without requiring additional testing if the represented measures of energy consumption continue to satisfy the applicable sampling provision.

(f)(1) For each basic model [1] of room air conditioners, a sample of sufficient size shall be tested to insure that—

(i) Any represented value of estimated annual operating cost, energy consumption or other measure of energy consumption of a basic model for which consumers would favor lower values shall be no less than the higher of (A) the mean of the sample or (B) the upper 97½ percent confidence limit of the true mean divided by 1.05, and

(ii) Any represented value of the energy efficiency ratio or other measure of energy consumption of a basic model for which consumers would favor higher values shall be no greater than the lower of (A) the mean of the sample or (B) the lower 97½ percent confidence limit of the true mean divided by .95.

(g)(1) For each basic model [1] of unvented home heating equipment (not including furnaces), a sample of sufficient size shall be tested to insure that—

(i) Any represented value of estimated annual operating cost, energy consumption or other measure of energy consumption of a basic model for which consumers would favor lower values shall be no less than the higher of (A) the mean of the sample or (B) the upper 97½ percent confidence limit of the true mean divided by 1.075, and

(ii) Any represented value of the annual fuel utilization efficiency or other measure of energy consumption of a basic model for which consumers would favor higher values shall be not greater than the lower of (A) the mean of the sample or (B) the lower 97½ percent confidence limit of the true mean divided by .925.

(h)(1) For each basic model [1] of television sets, a sample of sufficient size shall be tested to insure that—

(i) Any represented value of estimated annual operating cost, energy consumption or other measure of energy consumption of a basic model for which consumers would favor lower values shall be no less than the higher of (A) the mean of the sample or (B) the upper 97½ percent confidence limit of the true mean divided by 1.05, and

(ii) Any represented value of the energy factor or other measure of energy consumption of a basic model for which consumers would favor higher values shall be no greater than the lower of (A) the mean of the sample or (B) the lower 97½ percent confidence limit of the true mean divided by .95.

(i)(1) Except as provided in paragraph (i)(2) of this section, for each basic model [1] of conventional cooking tops, conventional ovens and microwave ovens a sample of sufficient size shall be tested to insure that—

(i) Any represented value of estimated annual operating cost, energy consumption or other measure of energy consumption of a basic model for which consumers would favor lower values shall be no less than the higher of (A) the mean of the sample or (B) the upper 97½ percent confidence limit of the true mean divided by 1.05, and

(ii) Any represented value of the energy factor or other measure of energy consumption of a basic model for which consumers would favor higher values shall be no greater than the lower of (A) the mean of the sample or (B) the lower 97½ percent confidence limit of the true mean divided by .95.

(2) Basic models need not be tested which differ from other tested basic models by only the design of oven doors the use of which leads to improved efficiency and decreased energy consumption and estimated annual operating cost. Any represented values of measures of energy consumption for basic models not tested shall be the same as for the tested basic model.

(j)(1) For each basic model [1] of clothes washers, a sample of sufficient size shall be tested to insure that—

(i) Any represented value of estimated annual operating cost, energy consumption or other measure of energy consumption of a basic model for which consumers would favor lower values shall be no less than the higher of (A) the mean of the sample or (B) the upper 97½ percent confidence limit of the true mean divided by 1.05, and

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[1] Components of similar design may be substituted without requiring additional testing if the represented measures of energy consumption continue to satisfy the applicable sampling provision.

(ii) Any represented value of the energy factor or other measure of energy consumption of a basic model for which consumers would favor higher values shall be no greater than the lower of (A) the mean of the sample or (B) the lower 97½ percent confidence limit of the true mean divided by .95.

(k)(1) For each basic model[1] of humidifiers, a sample of sufficient size shall be tested to insure that—

(i) Any represented value of estimated annual operating cost, energy consumption or other measure of energy consumption of a basic model for which consumers would favor lower values shall be no less than the higher of (A) the mean of the sample or (B) the upper 97½ percent confidence limit of the true mean divided by 1.05, and

(ii) Any represented value of the energy factor or other measure of energy consumption of a basic model for which consumers would favor higher values shall be no greater than the lower of (A) the mean of the sample or (B) the lower 97½ percent confidence limit of the true mean divided by .95.

(l)(1) For each basic model[1] of dehumidifier; a sample of sufficient size shall be tested to insure that—

(i) Any represented value of estimated annual operating cost, energy consumption or other measure of energy consumption of a basic model for which consumers would favor lower values shall be no less than the higher of (A) the mean of the sample or (B) the upper 97½ percent confidence limit of the true mean divided by 1.10, and

(ii) Any represented value of the energy factor or other measure of energy consumption of a basic model for which consumers would favor higher values shall be no greater than the lower of (A) the mean of the sample or (B) the lower 97½ percent confidence limit of the true mean divided by .90.

(m)(1) For central air conditioners, each condensing unit shall have a condenser-evaporator coil combination selected and a sample of sufficient size tested in accordance with applicable provisions of this subpart such that—

(i) Any represented value of estimated annual operating cost, energy consumption or other measure of energy consumption of the condenser-evaporator coil combination for which consumers would favor lower values shall be no less than the higher of (A) the mean of the sample or (B) the upper 90 percent confidence limit of the true mean divided by 1.05, and

(ii) Any represented value of the energy efficiency or other measure of energy consumption of the condenser-evaporator coil combination for which consumers would favor higher values shall be no greater than the lower of (A) the mean of the sample or (B) the lower 90 percent confidence limit of the true mean divided by 0.95.

(2) The condenser-evaporator coil combination selected for tests pursuant to paragraph (m)(1) of this section shall be that combination manufactured by the condensing unit manufacturer likely to have the largest volume of retail sales. Components of similar design may be substituted without requiring additional testing if the represented measures of energy consumption continue to satisfy the applicable sampling provisions of paragraphs (m)(1)(i) and (m)(1)(ii) of this section. For every other condenser-evaporator coil combination manufactured by the same manufacturer or in part by a component manufacturer using that same condensing unit, either—

(i) A sample of sufficient size, comprised of production units or representing production units, shall be tested to ensure that the requirements of paragraphs (m)(1)(i) and (m)(1)(ii) of this section are met for such other condenser-evaporator coil combinations; or

(ii) The representative values of the measures of energy consumption shall be based on an alternative rating method that has been approved by DOE in accordance with the provisions of paragraphs (m)(4) and (m)(5) of this section.

(3) Whenever the representative values of the measures of energy consumption, as determined by the provisions of paragraph (m)(2)(ii) of this section, do not agree within five percent of the representative values of the measures of energy consumption as determined by actual testing, the representative values determined by actual testing shall be used to comply with section 323(c) of the Act, or to comply with rules prescribed under section 324 of the Act.

(4) The basis of the alternative rating method referred to in paragraph (m)(2)(ii) of this section shall be a representation of the test data and calculations of a mechanical vapor compression refrigeration cycle. The major components in the refrigeration cycle shall be modeled as "fits" to manufacturer performance data or by graphic or tabular performance data. Heat transfer characteristics of coils may be modeled as a function of face area, number of rows, fins per inch, refrigerant circuitry, air flow rate and entering air enthalpy. Additional performance-related characteristics to be considered may include type of expansion device, refrigerant flow rate through the expansion device, power of the indoor fan and degradation coefficient.

(5) Manufacturers who elect to use an alternative rating method for determining measures of energy consumption under paragraphs (m)(2)(ii) and (m)(4) of this section must submit a request to DOE for reviewing the alternative rating method to the Assistant Secretary of Conservation and Renewable Energy, 1000 Independence Avenue, SW., Washington, DC 20585, and receive approval to use the alternative method by the Assistant Secretary before the alternative method may be used for rating central air conditioners.

(6) Each request to DOE for reviewing an alternative rating method shall include:

(i) The name, address and telephone number of the official representing the manufacturer.

(ii) Complete documentation of the alternative rating procedure, including the computer code when a computer model is used.

(iii) Test data for two coils from two different coil families for two different condensing units. The tested capacities for the matched systems for the two condensing units shall differ by at least a factor of two. Rating information for the mixed systems shall include the ratings from testing, and from the alternative rating method.

(iv) Complete test data, product information, and related information to allow DOE to verify the rating information submitted by the manufacturer.

(7) Manufacturers that elect to use an alternative rating method for determining measures of energy consumption under paragraphs (m)(2)(ii) and (m)(4) of this section must either subject a sample of their units to independent testing on a regular basis, e.g., voluntary certification program, or have the representations reviewed and certified by an independent state-registered professional engineer who is not an employee of the manufacturer. The registered professional engineer is to certify that the results of the alternative rating procedure accurately represent the energy consumption of the unit(s). The manufacturer is to keep the registered professional engineer's certifications on file for review by DOE for as long as said combination is made available for sale by the manufacturer. Any change to be made to the alternative rating method, must be approved by DOE prior to its use for rating.

(8) Manufacturers who choose to use computer simulation or engineering analysis for determining measures of energy consumption under paragraphs (m)(2)(ii) and (m)(5) of this section shall permit representatives of the Department of Energy to inspect for verification purposes the simulation method or methods used. This inspection may include conducting simulations to predict the performance of particular condenser-evaporator coil combinations specified by DOE, analysis of previous simulations conducted by a manufacturer, or both.

(n)(1) For each basic model[1] of furnaces, other than basic models of those sectional cast-iron boilers which may be aggregated into groups having identical intermediate sections and combustion chambers, a sample of sufficient size shall be tested to insure that—

(i) Any represented value of estimated annual operating cost, energy consumption or other measure of energy consumption of a basic model for which consumers would favor lower values shall be no less than the higher of (A) the mean of the sample, or (B) the upper 97½ percent confidence limit of the true mean divided by 1.05, and

(ii) Any represented value of the annual fuel utilization efficiency or other measure of energy consumption of a basic model for which consumers would favor higher values shall be no greater than the lower of (A) the mean of the sample, or (B) the lower 97½ percent confidence limit of the true mean divided by .95.

(2) For the lowest capacity basic model[1] of a group of basic models of those sectional cast-iron boilers having identical intermediate sections and combustion chambers, a sample of sufficient size shall be tested to insure that—

(i) Any represented value of estimated annual operating cost, energy consumption or other measure of energy consumption of a basic model for which consumers would favor lower values shall be no less than the higher of (A) the mean of the sample, or (B) the upper 97½ percent confidence limit of the true mean divided by 1.05, and

(ii) Any represented value of the fuel utilization efficiency or other measure of energy consumption of a basic model for which consumers would favor higher values shall be no greater than the lower of (A) the mean of the sample, or (B) the lower 97½ percent confidence limit of the true mean divided by .95.

(3) For the highest capacity basic model[1] of a group of basic models of those sectional cast-iron boilers having identical intermediate sections and combustion chambers, a sample of sufficient size shall be tested to insure that—

(i) Any represented value of estimated annual operating cost, energy consumption or other measure of energy consumption of a basic model for which consumers would favor lower values be no less than the higher of (A) the mean of the sample, or (B) the upper 97½ percent confidence limit of the true mean divided by 1.05, and

(ii) Any represented value of the fuel utilization efficiency or other measure of energy consumption of a basic model for which consumers would favor higher values shall be no greater than the lower of (A) the mean of the sample, or (B) the lower 97½ percent confidence limit of the true mean divided by .05.

(4) For basic model[1] or capacity other than the highest or lowest of the group of basic models[1] of sectional cast-iron boilers having identical intermediate sections and combustion chambers, represented values of measures of energy consumption shall be determined by either—

(i) A linear interpolation of data obtained for the smallest and largest capacity units of the family, or

(ii) Testing a sample of sufficient size to insure that (A) any represented value of estimated annual operating cost, energy consumption or other measure of energy consumption of a basic model for which consumers would favor lower values shall be no less than the higher of (*1*) the mean of the sample, or (*2*) the upper 97½ percent confidence limit of the true mean divided by 1.05, and (B) any represented value of the energy factor or other measure of energy consumption of a basic model for which consumers would favor higher values shall be no greater than the lower of (*1*) the mean of the sample, or (*2*) the lower 97½ percent confidence limit of the true mean divided by .95.

(5) Whenever measures of energy consumption determined by linear interpolation do not agree with measures of energy consumption determined by actual testing, the values determined by testing will be assumed to be the more reliable values.

(6) In calculating the measures of energy consumption for each unit

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[1] Components of similar design may be substituted without requiring additional testing if the represented measures of energy consumption continue to satisfy the applicable sampling provision.

tested, use the design heating requirement corresponding to the mean of the capacities of the units of the sample.

(o)(1) For each basic model[1] of vented home heating equipment (not including furnaces) a sample of sufficient size shall be tested to insure that—

(i) Any represented value of estimated annual operating cost, energy consumption or other measure of energy consumption of a basic model for which consumers would favor lower values shall be no less than the higher of (A) the mean of the sample or (B) the upper 97½ percent confidence limit of the true mean divided by 1.05, and

(ii) Any represented value of the fuel utilization efficiency or other measure of energy consumption of a basic model for which consumers would favor higher values shall be no greater than the lower of (A) the mean of the sample or (B) the lower 97½ percent confidence limit of the true mean divided by .95.

(2) In calculating the measures of energy consumption for each unit tested use the design heating requirement corresponding to the mean of the capacities of the units of the sample.

(p)(1) For each basic model[1] of pool heater a sample of sufficient size shall be tested to insure that—

(i) [Reserved]

(ii) Any represented value of the fuel utilization efficiency or other measure of energy consumption of a basic model for which consumers would favor higher values shall be no greater than the lower of (A) the mean of the sample or (B) the lower 97½ percent confidence limit of the true mean divided by .95.

(q) [Reserved]

(Energy Policy and Conservation Act, Pub. L. 94-163, as amended by Pub. L. 95-619; Department of Energy Organization Act, Pub. L. 95-91)

[44 FR 22416, Apr. 13, 1979, as amended at 44 FR 39153, July 5, 1979; 44 FR 76706, Dec. 27, 1979; 45 FR 53719, Aug. 12, 1980; 53 FR 8312, Mar. 14, 1988; 54 FR 6075, Feb. 7, 1989]

§ 430.27 Petitions for waiver and applications for interim waiver.

(a)(1) Any interested person may submit a petition to waive for a particular basic model any requirements of § 430.22, or of any appendix to this subpart, upon the grounds that the basic model contains one or more design characteristics which either prevent testing of the basic model according to the prescribed test procedures, or the prescribed test procedures may evaluate the basic model in a manner so unrepresentative of its true energy consumption characteristics as to provide materially inaccurate comparative data.

(2) Any interested person who has submitted a Petition for Waiver as provided in this subpart may also file an Application for Interim Waiver of the applicable test procedure requirements.

(b)(1) A Petition for Waiver shall be submitted, in triplicate, to the Assistant Secretary for Conservation and Renewable Energy, United States Department of Energy. Each Petition for Waiver shall:

(i) Identify the particular basic model(s) for which a waiver is requested, the design characteristic(s) constituting the grounds for the petition, and the specific requirements sought to be waived and shall discuss in detail the need for the requested waiver;

(ii) Identify manufacturers of all other basic models marketed in the United States and known to the petitioner to incorporate similar design characteristic(s);

(iii) Include any alternate test procedures known to the petitioner to evaluate in a manner representative of the energy consumption characteristics of the basic model; and

(iv) Be signed by the petitioner or by an authorized representative. In accordance with the provisions set forth in 10 CFR 1004.11, any request for confidential treatment of any information contained in a Petition for Waiver or in supporting documentation must be accompanied by a copy of the petition, application or supporting documentation from which the information claimed to be confidential has been deleted. DOE shall publish in the FEDERAL REGISTER the petition and supporting documents from which confidential information, as determined by DOE, has been deleted in accordance with 10 CFR 1004.11 and shall solicit comments, data and information with respect to the determination of the petition. Any person submitting written comments to DOE with the respect to a Petition for Waiver shall also send a copy of such comments to the petitioner. In accordance with paragraph (i) of this section, a petitioner may submit a rebuttal statement to the Assistant Secretary for Conservation and Renewable Energy.

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[1] Components of similar design may be substituted without requiring additional testing if the represented measures of energy consumption continue to satisfy the applicable sampling provision.

(2) An Application for Interim Waiver shall be submitted in triplicate, with the required three copies of the Petition for Waiver, to the Assistant Secretary for Conservation and Renewable Energy, U.S. Department of Energy. Each Application for Interim Waiver shall reference the Petition for Waiver by identifying the particular basic model(s) for which a waiver and temporary exception are being sought. Each Application for Interim Waiver shall demonstrate likely success of the Petition for Waiver and shall address what economic hardship and/or competitive disadvantage is likely to result absent a favorable determination on the Application for Interim Waiver. Each Application for Interim Waiver shall be signed by the applicant or by an authorized representative.

(c)(1) Each petitioner, after filing a Petition for Waiver with DOE, and after the Petition for Waiver has been published in the FEDERAL REGISTER, shall, within five working days of such publication, notify in writing all known manufacturers of domestically marketed units of the same product type (as listed in section 322(a) of the Act) and shall include in the notice a statement that DOE has published in the FEDERAL REGISTER on a certain date the Petition for Waiver and supporting documents from which confidential information, if any, as determined by DOE, has been deleted in accordance with 10 CFR 1004.11. Each petitioner, in complying with the requirements of this paragraph, shall file with DOE a statement certifying the names and addresses of each person to whom a notice of the Petition for Waiver has been sent.

(2) Each applicant for Interim Waiver, whether filing jointly with, or subsequent to, a Petition for Waiver with DOE, shall concurrently notify in writing all known manufacturers of domestically marketed units of the same product type (as listed in Section 322(a) of the Act) and shall include in the notice a copy of the Petition for Waiver and a copy of the Application for Interim Waiver. In complying with this section, each applicant shall in the written notification include a statement that the Assistant Secretary for Conservation and Renewable Energy will receive and consider timely written comments on the Application for Interim Waiver. Each applicant, upon filing an Application for Interim Waiver, shall in complying with the requirements of this paragraph certify to DOE that a copy of these documents have been sent to all known manufacturers of domestically marked units of the same product type (as listed in section 322(a) of the Act). Such certification shall include the names and addresses of such persons. Each applicant also shall comply with the provisions of paragraph (c)(1) of this section with respect to the petition for waiver.

(d) Any person submitting written comments to DOE with respect to an Application for Interim Waiver shall also send a copy of the comments to the applicant.

(e) If administratively feasible, applicant shall be notified in writing of the disposition of the Application for Interim Waiver within 15 business days of receipt of the application. Notice of DOE's determination on the Application for Interim Waiver shall be published in the FEDERAL REGISTER.

(f) The filing of an Application for Interim Waiver shall not constitute grounds for noncompliance with any requirements of this subpart, until an Interim Waiver has been granted.

(g) An Interim Waiver from test procedure requirements will be granted by the Assistant Secretary for Conservation and Renewable Energy if it is determined that the applicant will experience economic hardship if the Application for Interim Waiver is denied, if it appears likely that the Petition for Waiver will be granted, and/or the Assistant Secretary determines that it would be desirable for public policy reasons to grant immediate relief pending a determination on the Petition for Waiver.

(h) An interim waiver will terminate 180 days after issuance or upon the determination on the Petition for Waiver, whichever occurs first. An interim waiver may be extended by DOE for 180 days. Notice of such extension and/or any modification of the terms or duration of the interim waiver shall be published in the FEDERAL REGISTER, and shall be based on relevant information contained in the record and any comments received subsequent to issuance of the interim waiver.

(i) Following publication of the Petition for Waiver in the FEDERAL REGISTER, a petitioner may, within 10 working days of receipt of a copy of any comments submitted in accordance with paragraph (b)(1) of this section, submit a rebuttal statement to the Assistant Secretary for Conservation and Renewable Energy. A petitioner may rebut more than one response in a single rebuttal statement.

(j) The petitioner shall be notified in writing as soon as practicable of the disposition of each Petition for Waiver. The Assistant Secretary for Conservation and Renewable Energy shall issue a decision on the petition as soon as is practicable following receipt and review of the Petition for Waiver and other applicable documents, including, but not limited to, comments and rebuttal statements.

(k) The filing of a Petition for Waiver shall not constitute grounds for noncompliance with any requirements of this subpart, until a waiver or interim waiver has been granted.

(l) Waivers will be granted by the Assistant Secretary for Conservation and Renewable Energy, if it is determined that the basic model for which the waiver was requested contains a design characteristic which either prevents testing of the basic model according to the prescribed test procedures, or the prescribed test procedures may evaluate the basic model in a manner so unrepresentative of its true energy consumption characteristics as to provide materially inaccurate comparative data. Waivers may be granted subject to conditions, which may include adherence to alternate test procedures specified by the Assistant Secretary for Conservation and Renewable Energy. The Assistant Secretary shall consult with the Federal Trade Commission prior to granting any waiver, and shall promptly publish in the FEDERAL REGISTER notice of each waiver granted or denied, and any limiting conditions of each waiver granted.

(m) Within one year of the granting of any waiver, the Department of Energy will publish in the FEDERAL REGISTER a notice of proposed rulemaking to amend its regulations so as to eliminate any need for the continuation of such waiver. As soon thereafter as practicable, the Department of Energy will publish in the FEDERAL REGISTER a final rule. Such waiver will terminate on the effective date of such final rule.

(n) Any person aggrieved by an action under this section may file an appeal with the DOE's Office of Hearings and Appeals as provided in 10 CFR Part 205, Subpart H.

[51 FR 42826, Nov. 25, 1986]

APPENDIX A1 TO SUBPART B OF PART 430—UNIFORM TEST METHOD FOR MEASURING THE ENERGY CONSUMPTION OF ELECTRIC REFRIGERATORS AND ELECTRIC REFRIGERATOR-FREEZERS

1. Definitions

1.1 "HRF-1-1979" means the Association of Home Appliance Manufacturers standard for household refrigerators, combination refrigerator-freezers, and household freezers, also approved as an American National Standard as a revision of ANSI B 38.1-1970.

1.2 "Adjusted total volume" means the sum of (i) the fresh food compartment volume as defined in HRF-1-1979 in cubic feet, and (ii) the product of an adjustment factor and the net freezer compartment volume as defined in HRF-1-1979, in cubic feet.

1.3 "Anti-sweat heater" means a device incorporated into the design of a refrigerator or refrigerator-freezer to prevent the accumulation of moisture on exterior surfaces of the cabinet under conditions of high ambient humidity.

1.4 "All-refrigerator" means an electric refrigerator which does not include a compartment for the freezing and long time storage of food at temperatures below 32° F. (0.0° C.). It may include a compartment of 0.50 cubic feet capacity (14.2 liters) or less for the freezing and storage of ice.

1.5 "Cycle" means the period of 24 hours for which the energy use of an electric refrigerator or electric refrigerator-freezer is calculated as though the consumer activated compartment temperature controls were set so that the desired compartment temperatures were maintained.

1.6 "Cycle type" means the set of test conditions having the calculated effect of operating an electric refrigerator or electric refrigerator-freezer for a period of 24 hours, with the consumer activated controls other than those that control compartment temperatures set to establish various operating characteristics.

1.7 "Standard cycle" means the cycle type in which the anti-sweat heater control, when provided, is set in the highest energy consuming position.

1.8 "Automatic defrost" means a system in which the defrost cycle is automatically initiated and terminated, with resumption of normal refrigeration at the conclusion of the defrost operation. The system automatically prevents the permanent formation of frost on all refrigerated surfaces. Nominal refrigerated food temperatures are maintained during the operation of the automatic defrost system.

1.9 "Long-time Automatic Defrost" means an automatic defrost system where successive defrost cycles are separated by 14 hours or more of compressor-operating time.

1.10 "Stabilization Period" means the total period of time during which steady-state conditions are being attained or evaluated.

1.11 "Variable defrost control" means a long-time automatic defrost system (except the 14-hour defrost qualification does not apply) where successive defrost cycles are determined by an operating condition variable or variables other than solely compressor operating time. This includes any electrical or mechanical device. Demand defrost is a type of variable defrost control.

2. Test Conditions

2.1 Ambient temperature. The ambient temperature shall be 90.0 ± 1° F. (32.3±0.6° C.) during the stabilization period and during the test period. The ambient temperature shall be 80±2°F dry bulb and 67°F wet bulb during the stabilization period and during the test period when the unit is tested in accordance with section 3.3.

2.2 Operational conditions. The electric refrigerator or electric refrigerator-freezer shall be installed and its operating conditions maintained in accordance with HRF-1-1979, section 7.2 through section 7.4.3.3, except that the vertical ambient temperature gradient at locations 10 inches (25.4 cm) out from the centers of the two sides of the unit being tested is to be maintained during the test. Unless the area is obstructed by shields or baffles, the gradient is to be maintained from 2 inches (5.1 cm) above the floor or supporting platform to a height one foot (30.5 cm) above the unit under test. Defrost controls are to be operative and the anti-sweat heater switch is to be "on" during one test and "off" during a second test. Other exceptions are noted in 2.3, 2.4, and 5.1 below.

2.3 Conditions for automatic defrost refrigerator-freezers. For automatic defrost refrigerator-freezers, the freezer compartments shall not be loaded with any frozen food packages. Cylindrical metallic masses of dimensions 1.12 ± 0.25 inches (2.9±0.6 cm) in diameter and height shall be attached in good thermal contact with each temperature sensor within the refrigerated compartments. All temperature measuring sensor masses shall be supported by nonthermally conductive supports in such a manner that there will be at least one inch (2.5 cm) of air space separating the thermal mass from contact with any surface. In case of interference with hardware at the sensor locations specified in section 5.1, the sensors shall be placed at the nearest adjacent location such that there will be a one inch air space separating the sensor mass from the hardware.

2.4 Conditions for all-refrigerators. There shall be no load in the freezer compartment during the test.

2.5 Steady State Condition. Steady state conditions exist if the temperature measurements in all measured compartments taken at four minute intervals or less during a stabilization period are not changing at a rate greater than 0.042° F. (0.023° C.) per hour as determined by the applicable condition of A or B.

A. The average of the measurements during a two hour period if no cycling occurs or during a number of complete repetitive compressor cycles through a period of no less than two hours is compare to the average over an equivalent time period with three hours elapsed between the two measurement periods.

B. If A above cannot be used, the average of the measurements during a number of complete repetitive compressor cycles through a period of no less than two hours and including the last complete cycle prior to a defrost period, or if no cycling occurs, the average of the measurements during the last two hours prior to a defrost period; are compared to the same averaging period prior to the following defrost period.

3. Test Control Settings

3.1 Model with no user operable temperature control. A test shall be performed during which the compartment temperatures and energy use shall be measured. A second test shall be performed with the temperature control electrically short circuited to cause the compressor to run continuously.

3.2 Model with user operable temperature control. Testing shall be performed in accordance with one of the following sections using the standardized temperatures of:

All-refrigerator: 38° F. (3.3° C.) fresh food compartment temperature
Refrigerator: 15° F. (−9.4° C.) freezer compartment temperature
Refrigerator-freezer: 5° F. (−15° C.) freezer compartment temperature

Variable defrost control models: 5°F (−15°C) freezer compartment temperature and 38±2°F fresh food compartment temperature during steady-state conditions with no door-openings. If both settings cannot be obtained, then test with the fresh food compartment temperature at 38±2°F and the freezer compartment as close to 5°F as possible.

3.2.1 A first test shall be performed with all compartment temperature controls set at their median position midway between their warmest and coldest settings. Knob detents shall be mechanically defeated if necessary to attain a median setting. A second test shall be performed with all controls set at either their warmest or their coldest setting (not electrically or mechanically bypassed), whichever is appropriate, to attempt to achieve compartment temperatures measured during the two tests which bound (i.e., one is above and one is below) the standardized temperature for the type of product being tested. If the compartment temperatures measured during these two tests bound the appropriate standardized temperature, then these test results shall be used to determine energy consumption. If the compartment temperature measured with all controls set at their coldest setting is above the standardized temperature, a third test shall be performed with all controls set at their warmest setting and the result of this test shall be used with the result of the test performed with all controls set at their coldest setting to determine energy consumption. If the compartment temperature measured with all controls set at their warmest setting is below the standardized temperature; and the fresh food compartment temperature is below 45° F. (7.22° C.) in the case of a refrigerator or a refrigerator-freezer, excluding an all-refrigerator, then the result of this test alone will be used to determine energy consumption.

3.2.2 Alternatively, a first test may be performed with all temperature controls set at their warmest setting. If the compartment temperature is below the appropriate standardized temperature, and the fresh food compartment temperature is below 45° F. (7.22° C.) in the case of a refrigerator or a refrigerator-freezer, excluding an all-refrigerator, then the result of this test alone will be used to determine energy consumption. If the above conditions are not met, then the unit shall be tested in accordance with 3.2.1 above.

3.2.3 Alternatively, a first test may be performed with all temperature controls set at their coldest setting. If the compartment temperature is above the appropriate standardized temperature, a second test shall be performed with all controls set at their warmest control setting and the results of these two tests shall be used to determine energy consumption. If the above condition is not met, then the unit shall be tested in accordance with 3.2.1 above.

3.3 Variable defrost control optional test. After a steady-state condition is achieved, the optional test requires door-openings for 12±2 seconds every 60 minutes on the fresh food compartment door and a simultaneous 12±2 second freezer compartment door-opening occurring every 4th time, to obtain 24 fresh food and six freezer compartment door-openings per 24-hour period. The first freezer door-opening shall be simultaneous with the fourth fresh food door-opening. The doors are to be opened 60° to 90° with an average velocity for the leading edge of the door of approximately 2 ft./sec. Prior to the initiation of the door-opening sequence, the refrigerator defrost control mechanism may be re-initiated in order to minimize the test duration.

4. Test Period

4.1 Test Period. Tests shall be performed by establishing the conditions set forth in Section 2, and using control settings as set forth in Section 3, above.

4.1.1 Nonautomatic Defrost. If the model being tested has no automatic defrost system, the test time period shall start after steady state conditions have been achieved and be of not less than three hours in duration. During the test period, the compressor motor shall complete two or more whole compressor cycles (a compressor cycle is a complete "on" and a complete "off" period of the motor). If no "off" cycling will occur, as determined during the stabilization period, the test period shall be three hours. If incomplete cycling (less than two compressor cycles) occurs during a 24 hour period, the results of the 24 hour period shall be used.

4.1.2 Automatic Defrost. If the model being tested has an automatic defrost system, the test time period shall start after steady state conditions have been achieved and be from one point during a defrost period to the same point during the next defrost period. If the model being tested has a long-time automatic defrost system, the alternative provisions of 4.1.2.1 may be used.If the model being tested has a variable defrost control, the provisions of section 4.1.2.2 or 4.1.2.3 shall apply. If the model has a dual compressor system the provisions of 4.1.2.4 shall apply.

4.1.2.1 Long-time Automatic Defrost. If the model being tested has a long-time automatic defrost system, the test time period may consist of two parts. A first part would be the same as the test for a unit having no defrost provisions (section 4.1.1). The second part would start when a defrost period is initiated during a compressor "on" cycle and terminate at the second turn "on" of the compressor motor or after four hours, whichever comes first.

4.1.2.2 Variable defrost control. If the model being tested has a variable defrost control system, the test shall consist of three parts. Two parts shall be the same as the test for long-time automatic defrost (section 4.1.2.1). The third part is the optional test to determine the time between defrosts (section 5.2.1.3). The third part is used by manufacturers that choose not to accept the default value of F of 0.20, to calculate CT.

4.1.2.3 Variable defrost control optional test. After steady-state conditions with no door openings are achieved in accordance with section 3.3 above, the test is continued using the above daily door-opening sequence until stabilized operation is achieved. Stabilization is defined as a minimum of three consecutive defrost cycles with times between defrosts that will allow the calculation of a Mean Time Between Defrosts (MTBD1) that satisfies the statistical relationship of 90 percent confidence. The test is repeated on at least one more unit of the model and until the Mean Time Between Defrosts for the multiple unit tests (MTBD2) satisfies the statistical relationship. If the time between defrosts is greater than 96 hours (compressor "on" time) and this defrost period can be repeated on a second unit, the test may be terminated at 96 hours (CT) and the absolute time value used for MTBD for each unit.

4.1.2.4 Dual compressor systems with automatic defrost. If the model being tested has separate compressor systems for the refrigerator and freezer sections, each with its own automatic defrost system, then the two-part method in 4.1.2.1 shall be used. The second part of the method will be conducted separately for each automatic defrost system. The auxiliary components (fan motors, anti-sweat heaters, etc.) will be identified for each system and the energy consumption measured during each test.

5. Test Measurements

5.1 Temperature Measurements. Temperature measurements shall be made at the locations prescribed in Figures 7.1 and 7.2 of HRF-1-1979 and shall be accurate to within ± 0.5° F. (0.3° C.) of true value. No freezer temperature measurements need be taken in an all-refrigerator model.

If the interior arrangements of the cabinet do not conform with those shown in Figure 7.1 and 7.2 of HRF-1-1979, measurements shall be taken at selected locations chosen to represent approximately the entire refrigerated compartment. The locations selected shall be a matter of record.

5.1.1 Measured Temperature. The measured temperature of a compartment is to be the average of all sensor temperature readings taken in that compartment at a particular time. Measurements shall be taken at regular intervals not to exceed four minutes.

5.1.2 Compartment Temperature. The compartment temperature for each test period shall be an average of the measured temperatures taken in a compartment during a complete cycle or several complete cycles of the compressor motor (one compressor cycle is one complete motor "on" and one complete motor "off" period). For long-time automatic defrost models, compartment temperatures shall be those measured in the first part of the test period specified in 4.1.1. For models equipped with variable defrost controls, compartment temperatures shall be those measured in the first part of the test period specified in 4.1.2.2 above.

5.1.2.1 The number of complete compressor motor cycles over which the measured temperatures in a compartment are to be averaged to determine compartment temperature shall be equal to the number of minutes between measured temperature readings, rounded up to the next whole minute or a number of complete cycles over a time period exceeding one hour. One of the cycles shall be the last complete compressor motor cycle during the test period.

5.1.2.2 If no compressor motor cycling occurs, the compartment temperature shall be the average of the measured temperatures taken during the last thirty-two minutes of the test period.

5.1.2.3 If incomplete cycling occurs, the compartment temperatures shall be the average of the measured temperatures taken during the last three hours of the last complete "on" period.

5.2 Energy Measurements

5.2.1 Per-day Energy Consumption. The energy consumption in kilowatt-hours per day for each test period shall be the energy expended during the test period as specified in section 4.1 adjusted to a 24 hour period. The adjustment shall be determined as follows:

5.2.1.1 Nonautomatic and automatic defrost models. The energy consumption in kilowatt-hours per day shall be calculated equivalent to:

$ET = EP \times 1440/T$

where

ET = test cycle energy expended in kilowatt-hours per day,

EP = energy expended in kilowatt-hours during the test period,

T = length of time of the test period in minutes, and

1440 = conversion factor to adjust to a 24 hour period in minutes per day.

5.2.1.2 Long-time Automatic Defrost. If the two part test method is used, the energy consumption in kilowatt-hours per day shall be calculated equivalent to:

$ET = (1440 \times EP1/T1) + ((EP2 - (EP1 \times T2/T1)) \times 12/CT)$

where

ET and 1440 are defined in 5.2.1.1,

EP1 = energy expended in kilowatt-hours during the first part of the test,

EP2 = energy expended in kilowatt-hours during the second part of the test,

T1 and T2 = length of time in minutes of the first and second test parts respectively,

CT = Defrost timer run time in hours required to cause it to go through a complete cycle, to the nearest tenth hour per cycle, and

12 = factor to adjust for a 50% run time of the compressor in hours per day.

5.2.1.3 Variable defrost control. The energy consumption in kilowatt-hours per day shall be calculated equivalent to:

$ET = (1440 \times EP1/T1) + (EP2 - (EP1 \times T2/T1)) \times (12/CT)$ where 1440 is defined in 5.2.1.1 and EP1, EP2, T1, T2 and 12 are defined in 5.2.1.2.

$CT = CT_L \times CT_M)/(F \times (CT_M - CT_L) + CT_L)$

CT_L = least or shortest time between defrosts in tenths of an hour (greater than or equal to six but less than or equal to 12 hours)

CT_M = maximum time between defrost cycles in tenths of an hour (greater than CT_L but not more than 96 hours)

F = ratio of per day energy consumption in excess of the least energy and the maximum difference in per day energy consumption and is equal to

$F = (1/CT - 1/CT_M)/(1/CT_L - 1/CT_M$ = $(ET - ET_L)/ET_M - ET_L)$ or 0.20 in lieu of testing to find CT.

ET_L = least electrical energy used (kilowatt hours)

ET_M = maximum electrical energy used (kilowatt hours). For demand defrost models with no values for CT_L and CT_M in the algorithm the default values of 12 and 84 shall be used, respectively.

5.2.1.4 Optional test method for variable defrost controls.

$CT = MTBD \times 0.5$

where:

MTBD = mean time between defrosts

$$MTBD = \frac{\Sigma X}{N}$$

where:

X = in time between defrost cycles

N = number of defrost cycles

5.2.1.5 Dual compressor systems with dual automatic defrost. The two-part test method in section 4.1.2.2 must be used, the energy consumption in kilowatt per day shall be calculated equivalent to:

$ET = (1440 \times EP1/T1) + (EP2_F - (EP_F \times T2/T1)) \times 12/CT_F + (EP2_R - (EP_R \times T3/T1)) \times 12/CT_R$

Where 1440, EP1, T1, EP2, 12, and CT are defined in 5.2.1.2

EP_F = energy expended in kilowatt-hours during the second part of the test for the freezer system by the freezer system.

$EP2_F$ = total energy expended during the second part of the test for the freezer system.

EP_R = energy expended in kilowatt-hours during the second part of the test for the refrigerator system by the refrigerator system.

$EP2_R$ = total energy expended during the second part of the test for the refrigerator system.

T2 and T3 = length of time in minutes of the second test part for the freezer and refrigerator systems respectively.

CT_F = compressor "on" time between freezer defrosts (tenths of an hour).

CT_R = compressor "on" time between refrigerator defrosts (tenths of an hour).

5.3 Volume measurements. The electric refrigerator or electric refrigerator-freezer total refrigerated volume, VT, shall be measured in accordance with HRF-1-1979, section 3.20 and sections 4.2 through 4.3 and be calculated equivalent to:

$VT = VF + VFF$

where

VT = total refrigerated volume in cubic feet,

VF=freezer compartment volume in cubic feet, and
VFF=fresh food compartment volume in cubic feet.

6. Calculation of Derived Results from Test Measurements

6.1 Adjusted Total Volume.

6.1.1 Electric refrigerators. The adjusted total volume, VA, for electric refrigerators under test shall be defined as:

$$VA=(VF\times CR)+VFF$$

where
VA=adjusted total volume in cubic feet,
VF and VFF are defined in 5.3, and
CR=adjustment factor of 1.44 for refrigerators other than all-refrigerators, or 1.0 for all-refrigerators, dimensionless.

6.1.2 Electric refrigerator-freezers. The adjusted total volume, VA, for electric refrigerator-freezers under test shall be calculated as follows:

$$VA=(VF\times CRF)+VFF$$

where
VF and VFF are defined in 5.3 and VA is defined in 6.1.1,
CRF=adjustment factor of 1.63, dimensionless.

6.2 Average Per-Cycle Energy consumption.

6.2.1 All-refrigerator Models. The average per-cycle energy consumption for a cycle type is expressed in kilowatt-hours per cycle to the nearest one hundredth (0.01) kilowatt-hour and shall depend upon the temperature attainable in the fresh food compartment as shown below.

6.2.1.1 If the fresh food compartment temperature is always below 38.0° F. (3.3° C.), the average per-cycle energy consumption shall be equivalent to:

$$E=ET1$$

where
E=Total per-cycle energy consumption in kilowatt-hours per day,
ET is defined in 5.2.1, and Number 1 indicates the test period during which the highest fresh food compartment temperature is measured.

6.2.1.2 If one of the fresh food compartment temperatures measured for a test period is greater than 38.0° F. (3.3° C.), the average per-cycle energy consumption shall be equivalent to:

$$E=ET1+((ET2-ET1)\times(38.0-TR1)/(TR2-TR1))$$

where
E is defined in 6.2.1.1,
ET is defined in 5.2.1,
TR=Fresh food compartment temperature determined according to 5.1.2 in degrees F,
Number 1 and 2 indicates measurements taken during the first and second test period as appropriate, and
38.0=Standardized fresh food compartment temperature in degrees F.

6.2.2 Refrigerators and refrigerator-freezers. The average per-cycle energy consumption for a cycle type is expressed in kilowatt-hours per-cycle to the nearest one hundredth (0.01) kilowatt-hour and shall be defined in the applicable following manner.

6.2.2.1 If the fresh food compartment temperature is always at or below 45° F. (7.2° C.) in both of the tests and the freezer compartment temperature is always at or below 15° F. (−9.4° C.) in both tests of a refrigerator or at or below 5° F. (−15° C.) in both tests of a refrigerator-freezer, the per-cycle energy consumption shall be:

$$E=ET1$$

where
E is defined in 6.2.1.1,
ET is defined in 5.2.1, and
Number 1 indicates the test period during which the highest freezer compartment temperature was measured.

6.2.2.2 If the conditions of 6.2.2.1 do not exist, the per-cycle energy consumption shall be defined by the higher of the two values calculated by the following two formulas:

$$E=ET1+((ET2-ET1)\times(45.0-TR1)/(TR2-TR1))$$

and

$$E=ET1+((ET2-ET1)\times(k-TF1)/(TF2-TF1))$$

where
E is defined in 6.2.1.1,
ET is defined in 5.2.1,
TR and number 1 and 2 are defined in 6.2.1.2,
TF=Freezer compartment temperature determined according to 5.1.2 in degrees F,
45.0 is a specified fresh food compartment temperature in degree F, and
k is a constant 15.0 for refrigerators or 5.0 for refrigerator-freezers each being standardized freezer compartment temperature in degrees F.

[47 FR 34526, Aug. 10, 1982; 48 FR 13013, Mar. 29, 1983, as amended at 54 FR 36240, Aug. 31, 1989; 54 FR 38788, Sept. 20, 1989]

APPENDIX B1 to Subpart B of Part 430—UNIFORM TEST METHOD FOR MEASURING THE ENERGY CONSUMPTION OF FREEZERS

1. Definitions.

1.1 "HRF-1-1979" means the Association of Home Appliance Manufacturers standard for household refrigerators, combination refrigerators-freezers, and household freezers, also approved as an American National Standard as a revision of ANSI B38.1-1970.

1.2 "Anti-sweat heater" means a device incorporated into the design of a freezer to prevent the accumulation of moisture on exterior surfaces of the cabinet under conditions of high ambient humidity.

1.3 "Cycle" means the period of 24 hours for which the energy use of a freezer is calculated as though the consumer-activated compartment temperature controls were preset so that the desired compartment temperatures were maintained.

1.4 "Cycle type" means the set of test conditions having the calculated effect of operating a freezer for a period of 24 hours with the consumer-activated controls other than the compartment temperature control set to establish various operating characteristics.

1.5 "Standard cycle" means the cycle type in which the anti-sweat heater switch, when provided, is set in the highest energy consuming position.

1.6 "Adjusted total volume" means the product of, (1) the freezer volume as defined in HRF-1-1979 in cubic feet, times (2) an adjustment factor.

1.7 "Automatic Defrost" means a system in which the defrost cycle is automatically initiated and terminated, with resumption of normal refrigeration at the conclusion of defrost operation. The system automatically prevents the permanent formation of frost on all refrigerated surfaces. Nominal refrigerated food temperatures are maintained during the operation of the automatic defrost system.

1.8 "Long-time Automatic Defrost" means an automatic defrost system where successive defrost cycles are separated by 14 hours or more of compressor-operating time.

1.9 "Stabilization Period" means the total period of time during which steady-state conditions are being attained or evaluated

1.10 "Variable defrost control" means a long-time automatic defrost system (except the 14-hour defrost qualification does not apply) where successive defrost cycles are determined by an operating condition variable or variables other than solely compressor operating time. This includes any electrical or mechanical device. Demand defrost is a type of variable defrost control.

1.11 "Quick freeze" means an optional feature on freezers which is initiated manually and shut off manually. It bypasses the thermostat control and places the compressor in a steady-state operating condition until it is shut off.

2. Test Conditions.

2.1 Ambient temperature. The ambient temperature shall be 90.0±1.0° F. (32.2±0.6° C.) during the stabilization period and during the test period. The ambient temperature shall be 80±2°F dry bulb and 67°F wet bulb during the stabilization period and during the test period when the unit is tested in accordance with section 3.3.

2.2 Operational conditions. The freezer shall be installed and its operating conditions maintained in accordance with HRF-1-1979, section 7.2 through section 7.4.3.3, except that the vertical ambient gradient at locations 10 inches (25.4 cm) out from the the centers of the two sides of the unit being tested is to be maintained during the test. Unless the area is obstructed by shields or baffles, the gradient is to be maintained from 2 inches (5.1 cm) above the floor or supporting platform to a height one foot (30.5 cm) above the unit under test. Defrost controls are to be operative and the anti-sweat heater switch is to be "on" during one test and "off" during a second test. The quick freeze option shall be switched off unless specified.

2.3 Steady State Condition. Steady state conditions exist if the temperature measurements taken at four minute intervals or less during a stabilization period are not changing at a rate greater than 0.042° F. (0.023° C.) per hour as determined by the applicable condition of A or B.

A—The average of the measurements during a two hour period if no cycling occurs or during a number of complete repetitive compressor cycles through a period of no less than two hours is compared to the average over an equivalent time period with three hours elapsed between the two measurement periods.

B—If A above cannot be used, the average of the measurements during a number of complete repetitive compressor cycles through a period of no less than two hours and including the last complete cycle prior to a defrost period, or if no cycling occurs, the average of the measurements during the last two hours prior to a defrost period; are compared to the same averaging period prior to the following defrost period.

3. Test Control Settings.

3.1 Model with no user operable temperature control. A test shall be performed during which the compartment temperature and energy use shall be measured. A second test shall be performed with the temperature control electrically short circuited to cause the compressor to run continuously. If the model has the quick freeze option, it is to be used to bypass the temperature control.

3.2 Model with user operable temperature control. Testing shall be performed in accordance with one of the following sections using the standardized temperature of 0.0° F. (−17.8° C.). Variable defrost control models shall achieve 0±2°F during the steady-state conditions prior to the optional test with no door openings.

3.2.1 A first test shall be performed with all temperature controls set at their median position midway between their warmest and coldest settings. Knob detents shall be mechanically defeated if necessary to attain a median setting. A second test shall be performed with all controls set at either their warmest or their coldest setting (not electrically or mechanically bypassed), whichever is appropriate, to attempt to achieve compartment temperatures measured during the two tests which bound (i.e., one is above and one is below) the standardized temperature. If the compartment temperatures measured during these two tests bound the standardized temperature, then these test results shall be used to determine energy consumption. If the compartment temperature measured with all controls set at their coldest setting is above the standardized temperature, a third test shall be performed with all controls set at their warmest setting and the result of this test shall be used with the result of the test performed with all controls set at their coldest setting to determine energy consumption. If the compartment temperature measured with all controls set at their warmest setting is below the standardized temperature; then the result of this test alone will be used to determine energy consumption.

3.2.2 Alternatively, a first test may be performed with all temperature controls set at their warmest setting. If the compartment temperature is below the standardized temperature, then the result of this test alone will be used to determine energy consumption. If the above condition is not met, then the unit shall be tested in accordance with 3.2.1 above.

3.2.3 Alternatively, a first test may be performed with all temperature controls set at their coldest setting. If the compartment temperature is above the standardized temperature, a second test shall be performed with all controls set at their warmest setting and the results of these two tests shall be used to determine energy consumption. If the above condition is not met, then the unit shall be tested in accordance with 3.2.1 above.

3.3 Variable defrost control optional test. After a steady-state condition is achieved, the door-opening sequence is initiated with an 18±2 second freezer door-opening occurring every eight hours to obtain three door-openings per 24-hour period. The first freezer door-opening shall occur at the initiation of the test period. The door(s) are to be opened 60 to 90° with an average velocity for the leading edge of the door of approximately two feet per second. Prior to the initiation of the door-opening sequence, the freezer defrost control mechanism may be re-initiated in order to minimize the test duration.

4. Test Period.

4.1 Test Period. Tests shall be performed by establishing the conditions set forth in Section 2 and using control settings as set forth in Section 3 above.

4.1.1 Nonautomatic Defrost. If the model being tested has no automatic defrost system, the test time period shall start after steady state conditions have been achieved, and be of not less than three hours' duration. During the test period the compressor motor shall complete two or more whole cycles (a compressor cycle is a complete "on" and a complete "off" period of the motor). If no "off" cycling will occur, as determined during the stabilization period, the test period shall be three hours. If incomplete cycling (less than two compressor cycles) occurs during a 24 hour period, the results of the 24 hour period shall be used.

4.1.2 Automatic Defrost. If the model being tested has an automatic defrost system, the test time period shall start after steady state conditions have been achieved and be from one point during a defrost period to the same point during the next defrost period. If the model being tested has a long-time automatic defrost system, the alternate provisions of 4.1.2.1 may be used. If the model being tested has a variable defrost control the provisions of 4.1.2.2. shall apply.

4.1.2.1 Long-time Automatic Defrost. If the model being tested has a long-time automatic defrost system, the test time period may consist of two parts. A first part would be the same as the test for a unit having no defrost provisions (section 4.1.1). The second part would start when a defrost period is initiated during a compressor "on" cycle and terminate at the second turn "on" of the compressor motor or after four hours, whichever comes first.

4.1.2.2 Variable defrost control. If the model being tested has a variable defrost control system, the test shall consist of three parts. Two parts shall be the same as the test for long-time automatic defrost in accordance with section 4.1.2.1 above. The third part is the optional test to determine the time between defrosts (5.2.1.3). The third part is used by manufacturers that choose not to accept the default value of F of 0.20, to calculate CT.

4.1.2.3 Variable defrost control optional test. After steady-state conditions with no door-openings are achieved in accordance with section 3.3 above, the test is continued using the above daily door-opening sequence until stabilized operation is achieved. Stabilization is defined as a minimum of three consecutive defrost cycles with times between defrost that will allow the calculation of a Mean Time Between Defrosts (MTBD1) that satisfies the statistical relationship of 90 percent confidence. The test is repeated on at least one more unit of the model and until the Mean Time Between Defrosts for the multiple unit test (MTBD2) satisfies the statistical relationship. If the time between defrosts is greater than 96 hours (compressor "on" time) and this defrost period can be repeated on a second unit, the test may be terminated at 96 hours (CT) and the absolute time value used for MTBD for each unit.

5. *Test Measurements.*

5.1 Temperature Measurements. Temperature measurements shall be made at the locations prescribed in Figure 7-2 of HRF-1-1979 and shall be accurate to within ±0.5° F. (0.3° C.) of true value.

5.1.1 Measured Temperature. The measured temperature is to be the average of all sensor temperature readings taken at a particular time. Measurements shall be taken at regular intervals not to exceed four minutes.

5.1.2 Compartment Temperature. The compartment temperature for each test period shall be an average of the measured temperatures taken during a complete cycle or several complete cycles of the compressor motor (one compressor cycle is one complete motor "on" and one complete motor "off" period). For long-time automatic defrost models, compartment temperature shall be that measured in the first part of the test period specified in 4.1.1. For models equipped with variable defrost controls, compartment temperatures shall be those measured in the first part of the test period specified in 4.1.2.2.

5.1.2.1 The number of complete compressor motor cycles over which the measured temperatures in a compartment are to be averaged to determine compartment temperature shall be equal to the number of minutes between measured temperature readings rounded up to the next whole minute or a number of complete cycles over a time period exceeding one hour. One of the cycles shall be the last complete compressor motor cycles during the test period.

5.1.2.2 If no compressor motor cycling occurs, the compartment temperature shall be the average of the measured temperatures taken during the last thirty-two minutes of the test period.

5.1.2.3 If incomplete cycling occurs (less than one cycle) the compartment temperature shall be the average of all readings taken during the last three hours of the last complete "on" period.

5.2 Energy Measurements:

5.2.1 Per-day Energy Consumption. The energy consumption in kilowatt-hours per day for each test period shall be the energy expended during the test period as specif in section 4.1 adjusted to a 24 hour peri

The adjustment shall be determined follows:

5.2.1.1 Nonautomatic and automatic d frost models. The energy consumption i kilowatt-hours per day shall be calculate equivalent to:

$ET=(EP\times 1440\times K)/T$ where

ET=test cycle energy expended in kilowat hours per day,

EP=energy expended in kilowatt-hour during the test period.

T=length of time of the test period in min utes,

1440=conversion factor to adjust to a 2 hour period in minutes per day, and

K=correction factor of 0.7 for chest freeze and 0.85 for upright freezers to adju for average household usage, dimension less.

5.2.1.2 Long-time Automatic Defrost. I the two part test method is used, the ener consumption in kilowatt-hours per day sha be calculated equivalent to:

$$ET=(1440\times K\times EP1/T1)$$
$$((EP2-(EP1\times T2/T1))\times K\times 12/CT)$$

where

ET, 1440, and K are defined in 5.2.1.1

$EP1$=energy expended in kilowatt-hour during the first part of the test.

$EP2$=energy expended in kilowatt-hour during the second part of the test,

CT=Defrost timer run time in hours re quired to cause it to go through a com plete cycle, to the nearest tenth hou per cycle,

12=conversion factor to adjust for a 50% run time of the compressor in hours pe day, and

$T1$ and $T2$=length of time in minutes of th first and second test parts respectively.

5.2.1.3 Variable defrost control. The energy consumption in kilowatt-hours pe day shall be calculated equivalent to:

$ET=(1440 \text{ x } EP1/T1) + (EP2 - (EP1 \text{ x } T2/$ $T1) \text{ x } (12/CT)$ where 1440 is defined i 5.2.1.1 and EP1, EP2, T1, T2 and 12 ar defined in 5.2.1.2.

$CT=(CT_L \text{ x } CT_M)/(F\text{x } (CT_M - CT_L) + CT_L$

where:

CT_L=least or shortest time between defros in tenths of an hour (greater than o equal to 6 hours but less than or equa to 12 hours, $6 <_L < 12$)

CT_M=maximum time between defrost cycle in tenths of an hour (greater than CT_L but not more than 96 hours, $CT_L < CT_M$ < 96)

F=ratio of per day energy consumption i excess of the least energy and the maximum difference in per day energy consumption and is equal to

$F = (1/CT - 1/CT_M)/(1/CT_L - 1/CT_M) = (ET - ET_L)/(ET_M - ET_L)$ or 0.20 in lieu of testing to find CT

ET_L = least electrical energy consumed, in kilowatt hours

ET_M = maximum electrical energy consumed, in kilowatt hours

For demand defrost models with no values for CT_L and CT_M in the algorithm the default values of 12 and 84 shall be used, respectively.

5.2.1.4 Variable defrost control optional test. Perform the optional test for variable defrost control models to find CT.

$CT = MTBD \times 0.5$

MTBD = mean time between defrost

$$MTBD = \frac{\Sigma X}{N}$$

X = time between defrost cycles

N = number of defrost cycles

5.3 Volume measurements. The total refrigerated volume, VT, shall be measured in accordance with HRF-1-1979, section 3.20 and section 5.1 through 5.3.

6. *Calculation of Derived Results From Test Measurements.*

6.1 Adjusted Total Volume. The adjusted total volume, VA, for freezers under test shall be defined as:

$VA = VT \times CF$

where

VA = adjusted total volume in cubic feet,

VT = total refrigerated volume in cubic feet, and

CF = Correction factor of 1.73, dimensionless.

6.2 Average Per Cycle Energy Consumption:

6.2.1 The average per-cycle energy consumption for a cycle type is expressed in kilowatt-hours per cycle to the nearest one hundredth (0.01) kilowatt-hour and shall depend upon the compartment temperature attainable as shown below.

6.2.1.1 If the compartment temperature is always below 0.0° F. (−17.8° C.), the average per-cycle energy consumption shall be equivalent to:

$E = ET1$

where

E = Total per-cycle energy consumption in kilowatt-hours per day.

ET is defined in 5.2.1, and

Number 1 indicates the test period during which the highest compartment temperature is measured.

6.2.1.2 If one of the compartment temperatures measured for a test period is greater than 0.0° F. (17.8° C.), the average per-cycle energy consumption shall be equivalent to:

$E = ET1 + ((ET2 - ET1) \times (0.0 - TF1)/(TF2 - TF1))$

where

E is defined in 6.2.1.1

ET is defined in 5.2.1

TF = compartment temperature determined according to 5.1.2 in degrees F.

Numbers 1 and 2 indicate measurements taken during the first and second test period as appropriate, and

0.0 = Standardized compartment temperature in degrees F.

[47 FR 34528, Aug. 10, 1982; 48 FR 13013, Mar. 29, 1983, as amended at 54 FR 36241, Aug. 31, 1989; 54 FR 38788, Sept. 20, 1989]

Appendix C to Subpart B of Part 430—Uniform Test Method for Measuring the Energy Consumption of Dishwashers

1. *Definitions:* 1.1 "Cycle" means a sequence of operations of a dishwasher which performs a complete dishwashing operation, and may include variations or combinations of the functions of washing, rinsing and drying.

1.2 "Cycle type" means any complete sequence of operations capable of being preset on the dishwasher prior to the initiation of machine operation.

1.3 "Normal cycle" means the cycle type recommended by the manufacturer for completely washing a full load of normally soiled dishes including the power-dry feature.

1.4 "Power-dry feature" means that function in a cycle in which electrically generated heat is introduced into the washing chamber for the purpose of improving the drying performance of the dishwasher.

1.5 "Truncated normal cycle" means the normal cycle interrupted to eliminate the power-dry feature after the termination of the last rinse operation.

1.6 "Water Heating Dishwasher" means a dishwasher which is designed for hearing cold inlet water (nominal 50° F) or a dishwasher for which the manufacturer recommends operation with a nominal inlet water temperature of 120 °F, and may operate at either of these inlet water temperatures by providing internal water heating to above 120 °F in at least one wash phase of the normal cycle.

2. *Testing conditions:* 2.1 *Installation.* Install the dishwasher in accordance with the manufacturer's instruction, except that undercounter dishwashers need not be installed under a counter.

2.2 *Electrical supply.*

2.2.1 *Dishwashers that operate with an electrical supply of 115 volts.* Maintain the electrical supply to the dishwasher within two percent of 115 volts and within one percent of the nameplate frequency as specified by the manufacturer.

2.2.2 *Dishwashers that operate with an electricial supply of 240 volts.* Maintain the electrical supply to the dishwasher within two percent of 240 volts and within one percent of its nameplate frequency as specified by the manufacturer.

2.3 *Water temperature.*

2.3.1 *Dishwashers to be tested at a nominal 140°F inlet water temperature.* Maintain the water supply temperature between 135°F and 145°F.

2.3.2 Dishwashers to be tested at a nominal 120°F inlet water temperature. Maintain the water supply temperature between 118°F and 122°F.

2.3.3 *Dishwashers to be tested at a nominal 50°F inlet water temperature.* Maintain the water supply temperature between 48°F *and 52°* F.

2.4 *Water pressure.* Maintain the pressure of the water supply between 32.5 and 37.5 pounds per square inch.

2.5 *Ambient and machine temperature.* Maintain the room ambient air temperature between 70°F and 85°F, and assure that the dishwasher and the test load are at room ambient temperature at the start of each test cycle.

2.6 *Load.*

2.6.1 *Dishwashers to be tested at a nominal 140°F inlet water temperature.* The dishwasher shall be tested on the normal cycle and the truncated normal cycle without a test load.

2.6.2 *Dishwashers to be tested at a nominal inlet water temperature of 50°F or 120°F.* The dishwasher shall be tested or normal cycle and the truncated normal cycle with a test load of eight place settings plus six serving pieces as specified in section 6.1.1 of AHAM Standard DW-1. If the capacity of the dishwasher, as stated by the manufacturer, is less than eight place setting then the test load shall be that capacity.

2.7 *Testing requirements.* Provisions in this Appendix pertaining to dishwashers which operate with a nominal inlet temperature of 50° F or 120° F shall apply only to water heating dishwashers.

3. *Test cycle and measurements.*

3.1 *Test cycle.* Perform a test cycle by establishing the testing conditions set forth in 2 of this Appendix, setting the dishwasher to the cycle type to be tested, initiating the cycle and allowing the cycle to proceed to completion.

3.2 *Machine electrical energy consumption.*

3.2.1 *Dishwashers that operate with a nominal 140°F inlet water temperature, only.* Measure the machine electrical energy consumption, M, specified as the number of kilowatt-hours of electrical energy consumed during the entire test cycle using a water supply temperature as set forth in 2.3.1 of this Appendix. Use a kilowatt-hour meter having a resolution no larger than 0.001 kilowatt hours and a maximum error no greater than one percent.

3.2.2 *Dishwashers that operate with a nominal inlet water temperature of 120°F.* Measure the machine electrical energy consumption, M, specified as the number of kilowatt-hours of electrical energy consumed during the entire test cycle using a water supply temperature as set forth in 2.3.2 of this Appendix. Use a kilowatt-hour meter having a resolution no larger than 0.001 kilowatt-hours and a maximum error no greater than one percent.

3.2.3 *Dishwashers that operate with a nominal inlet water temperature of 50°F.* Measure the machine electrical energy consumption, M, specified as the number of kilowatt-hours of electrical energy consumed during the entire test cycle using a water supply temperature as set forth in 2.3.3 of this appendix. Use a kilowatt-hour meter having a resolution no longer than 0.001 kilowatt-hours and a maximum error no greater than one percent.

3.3 *Water consumption.* Measure the water consumption specified as the number of gallons delivered to the dishwasher during the entire test cycle, using a water meter having a resolution no larger than 0.1 gallon and a maximum error no greater than 1.5 percent for all water flow rates from one to five gallons per minute and for all water temperatures encountered in the test cycle.

3.4 *Report values.* State the reported values of machine electrical energy consumption and water consumption as measured.

4. *Calculation of derived results from test measurements:* 4.1 *Per-cycle water energy consumption using electrically heated water.*

4.1.1 *Dishwashers that operate with a nominal 140°F inlet water temperature, only.* Calculate for the cycle type under test the per-cycle water energy consumption using electrically heated water, We, expressed in kilowatt-hours per cycle and defined as:

$W_e = V \times T \times K$,

where

V = reported water consumption in gallons per cycle for the cycle type under test.

T = nominal water heater temperature rise = 90°F.

K = specific heat of water in kilowatt-hours per gallon per degree Fahrenheit = 0.00240.

4.1.2 *Dishwashers that operate with a nominal inlet water temperature of 120°F.* Calculate for the cycle type under test the per cycle water energy consumption using electrically heated water, We, expressed in kilowatt-hours per cycle and defined as:

$We = V \times T' \times K$

where

V and K are defined in 4.1.1 of this Appendix and T'=nominal water heated temperature rise=70°F.

4.2 *Per cycle water energy consumption using gas-heated or oil-heated water.*

4.2.1 *Dishwashers that operate with a nominal 140°F inlet water temperature, only.* Calculate for the cycle type under test the per cycle water energy consumption using gas-heated or oil-heated water, We, expressed in Btu's per cycle and defined as:

$Wg = V \times T \times C/e.$

where

V and T are defined in 4.1.1 of this Appendix, and

C=specific heat of water in Btu's per gallon per degree fahrenheit=8.20

e=nominal gas or oil water heater recovery efficiency=0.75.

4.2.2 *Dishwashers that operate with a nominal inlet water temperature of 120°F.* Calculate for the cycle type under test the per cycle water energy consumption using gas-heated or oil-heated water, Wg, expressed in Btu's per cycle and defined as:

$W_g = V \times T' \times C/e$

where

V and T' are defined in 4.1.2 of this Appendix, and C and e are defined in 4.2.1 of this Appendix.

4.3 *Per-cycle machine electrical energy consumption.*

4.3.1 *Dishwashers that operate with a nominal 140°F inlet water temperature, only.* Use the measured value recorded in 3.2.1 as the per-cycle machine electrical energy consumption, *M*, expressed in kilowatt-hours per cycle.

4.3.2 *Dishwashers that operate with a nominal inlet water temperature of 120°F.* Use the measured value recorded in 3.2.2 as the per-cycle machine electrical energy consumption, *M*, expressed in kilowatt-hours per cycle.

4.3.3 *Dishwashers that operate with a nominal inlet water temperature of 50°F.* Use the measured value recorded at 3.2.3 as the per-cycle machine electrical consumption, M, expressed in kilowatt-hours per-cycle.

4.4 *Total per-cycle energy consumption.* Calculate for the cycle type under test the total per-cycle energy consumption, *E*, expressed in kilowatt-hours per cycle, and defined as the sum of the per-cycle machine electrical energy consumption, *M*, plus the per-cycle water energy consumption of electrically-heated water, *W*, calculated for the cycle type, determined according to 4.3 and 4.1 respectively.

[48 FR 9206, Mar. 3, 1983, as amended at 49 FR 46536, Nov. 27, 1984; 49 FR 47479, Dec. 5, 1984; 52 FR 47551, Dec. 15, 1987]

APPENDIX D TO SUBPART B OF PART 430—UNIFORM TEST METHOD FOR MEASURING THE ENERGY CONSUMPTION OF CLOTHES DRYERS

1. DEFINITIONS

1.1 "AHAM" means the Association of Home Appliance Manufacturers.

1.2 "Bone dry" means a condition of a load of test clothes which has been dried in a dryer at maximum temperature for a minimum of 10 minutes, removed and weighed before cool down, and then dried again for 10-minute periods until the final weight change of the load is 1 percent or less.

1.3 "Compact" or compact size" means a clothes dryer with a drum capacity of less than 4.4 cubic feet.

1.4 "Cool down" means that portion of the clothes drying cycle when the added gas or electric heat is terminated and the clothes continue to tumble and dry within the drum.

1.5 "Cycle" means a sequence of operation of a clothes dryer which performs a clothes drying operation, and may include variations or combinations of the functions of heating, tumbling and drying.

1.6 "Drum capacity" means the volume of the drying drum in cubic feet.

1.7 "HLD-1" means the test standard promulgated by AHAM and titled "AHAM Performance Evaluation Procedure for Household Tumble Type Clothes Dryers", June 1974, and designated as HLD-1.

1.8 "HLD-2EC" means the test standard promulgated by AHAM and titled "Test Method for Measuring Energy Consumption of Household Tumble Type Clothes Dryers," December 1975, and designated as HLD-2EC.

1.9 "Standard size" means a clothes dryer with a drum capacity of 4.4 cubic feet or greater.

1.10 "Moisture content" means the ratio of the weight of water contained by the test load to the bone-dry weight of the test load, expressed as a percent.

1.11 "Automatic termination control" means a dryer control system with a sensor which monitors either the dryer load temperature or its moisture content and with a controller which automatically terminates the drying process. A mark or detent which indicates a preferred automatic termination control setting must be present if the dryer is to be classified as having an "automatic termination control." A mark is a visible single control setting on one or more dryer controls.

1.12 "Temperature sensing control" means a system which monitors dryer exhaust air temperature and automatically terminates the dryer cycle.

1.13 "Moisture sensing control" means a system which utilizes a moisture sensing element within the dryer drum that monitors the amount of moisture in the clothes and automatically terminates the dryer cycle.

2. TESTING CONDITIONS

2.1 *Installation.* Install the clothes dryer in accordance with manufacturer's instructions. The dryer exhaust shall be restricted by adding the AHAM exhaust simulator described in 3.3.5 of HLD-1. All external joints should be taped to avoid air leakage. Disconnect all console light or other lighting systems on the clothes dryer which do not consume more than 10 watts during the clothes dryer test cycle.

2.2 *Ambient temperature and humidity.* Maintain the room ambient air temperature at 75 ±3° F and the room relative humidity at 50±10 percent relative humidity.

2.3 Energy supply.

2.3.1 *Electrical supply.* Maintain the electrical supply at the clothes dryer terminal block within 1 percent of 120/240 or 120/208Y or 120 volts as applicable to the particular terminal block wiring system and within 1 percent of the nameplate frequency as specified by the manufacturer. If the dryer has a dual voltage conversion capability, conduct test at the highest voltage specified by the manufacturer.

2.3.2 *Gas supply.*

2.3.2.1 *Natural gas.* Maintains the gas supply to the clothes dryer at a normal inlet test pressure immediately ahead of all controls at 7 to 10 inches of water column. If the clothes dryer is equipped with a gas appliance pressure regulator, the regulator outlet pressure at the normal test pressure shall be approximately that recommended by the manufacturer. The hourly Btu rating of the burner shall be maintained within ±5 percent of the rating specified by the manufacturer. The natural gas supplied should have a heating value of approximately 1,025 Btu's per standard cubic foot. The actual heating value, H_n2, in Btu's per standard cubic foot, for the natural gas to be used in the test shall be obtained either from measurements made by the manufacturer conducting the test using a standard continuous flow calorimeter as described in 2.4.6 or by the purchase of bottled natural gas whose Btu rating is certified to be at least as accurate a rating as could be obtained from measurements with a standard continuous flow calorimeter as described in 2.4.6.

2.3.2.2 *Propane gas.* Maintain the gas supply to the clothes dryer at a normal inlet test pressure immediately ahead of all controls at 11 to 13 inches of water column. If the clothes dryer is equipped with a gas appliance pressure regulator, the regulator outlet pressure at the normal test pressure shall be approximately that recommended by the manufacturer. The hourly Btu rating of the burner shall be maintained within ±5 percent of the rating specified by the manufacturer. The propane gas supplied should have a heating value of approximately 2,500 Btu's per standard cubic foot. The actual heating value, H_p, in Btu's per standard cubic foot, for the propane gas to be used in the test shall be obtained either from measurements made by the manufacturer conducting the test using a standard continuous flow calorimeter as described in 2.4.6 or by the purchase of bottled gas whose Btu rating is certified to be at least as accurate a rating as could be obtained from measurement with a standard continuous calorimeter as described in 2.4.6.

2.4 *Instrumentation.* Perform all test measurements using the following instruments as appropriate.

2.4.1 *Weighing scale for test cloth.* The scale shall have a range of 0 to a maximum of 30 pounds with a resolution of at least 0.2 ounces and a maximum error no greater than 0.3 percent of any measured value within the range of 3 to 15 pounds.

2.4.1.2 *Weighing scale for drum capacity measurements.* The scale should have a range of 0 to a maximum of 500 pounds with resolution of 0.50 pounds and a maximum error no greater than 0.5 percent of the measured value.

2.4.2 *Kilowatt-hour meter.* The kilowatt-hour meter shall have a resolution of 0.001 kilowatt-hours and a maximum error no greater than 0.5 percent of the measured value.

2.4.3 *Gas meter.* The gas meter shall have a resolution of 0.001 cubic feet and a maximum error no greater than 0.5 percent of the measured value.

2.4.4 *Dry and wet bulb psychrometer.* The dry and wet bulb psychrometer shall have an error no greater than ±1°F.

2.4.5 *Temperature.* The temperature sensor shall have an error no greater than ±1°F.

2.4.6 *Standard Continuous Flow Calorimeter.* The Calorimeter shall have an operating range of 750 to 3,500 Btu per cubic feet. The maximum error of the basic calorimeter shall be no greater than 0.2 percent of the actual heating value of the gas used in the test. The indicator readout shall have a maximum error no greater than 0.5 percent of the measured value within the operating range and a resolution of 0.2 percent of the full scale reading of the indicator instrument.

2.5 *Lint trap.* Clean the lint trap thoroughly before each test run.

2.6 *Test cloths.*

2.6.1 *Energy test cloth.* The energy test cloth shall be clean and consist of the following:

(a) Pure finished bleached cloth, made with a momie or granite weave, which is a blended fabric of 50 percent cotton and 50 percent polyester and weighs within +10 percent of 5.75 ounces per square yard after test cloth preconditioning and has 65 ends on the warp and 57 picks on the fill. The individual warp and fill yarns are a blend of 50 percent cotton and 50 percent polyester fibers.

(b) Cloth material that is 24 inches by 36 inches and has been hemmed to 22 inches by 34 inches before washing. The maximum shrinkage after five washes shall not be more than four percent on the length and width.

(c) The number of test runs on the same energy test cloth shall not exceed 25 runs.

2.6.2 *Energy stuffer cloths.* The energy stuffer cloths shall be made from energy test cloth material and shall consist of pieces of material that are 12 inches by 12 inches and have been hemmed to 10 inches by 10 inches before washing. The maximum shrinkage after five washes shall not be more than four percent on the length and width. The number of test runs on the same energy stuffer cloth shall not exceed 25 runs after test cloth preconditioning.

2.6.3 *Test Cloth Preconditioning.*

A new test cloth load and energy stuffer cloths shall be treated as follows:

(1) Bone dry the load to a weight change of ±1 percent, or less, as prescribed in Section 1.2.

(2) Place test cloth load in a standard clothes washer set at the maximum water fill level. Wash the load for 10 minutes in soft water (17 parts per million hardness or less), using 6.0 grams of AHAM Standard Test Detergent, IIA, per gallon of water. Wash water temperature is to controlled at 140°±5°F (60°±2.7°C). Rinse water temperature is to be controlled at 100°±5°F (37.7±2.7°C).

(3) Rinse the load again at the same water temperature.

(4) Bone dry the load as prescribed in Section 1.2 and weigh the load.

(5) This procedure is repeated until there is a weight change of one percent or less.

(6) A final cycle is to be a hot water wash with no detergent, followed by two warm water rinses.

2.7 *Test loads.*

2.7.1 *Compact size dryer load.* Prepare a bone-dry test load of energy cloths which weighs 3.00 pounds ±.03 pounds. Adjustments to the test load to achieve the proper weight can be made by the use of energy stuffer cloths, with no more than five stuffer cloths per load. Dampen the load by agitating it in water whose temperature is 100°±5° F and consists of 0 to 17 parts per million hardness for approximately two minutes in order to saturate the fabric. Then, extract water from the wet test load by spinning the load until the moisture content of the load is between 66.5 percent to 73.5 percent of the bone-dry weight of the test load.

2.7.2 *Standard size dryer load.* Prepare a bone-dry test load of energy cloths which weighs 7.00 pounds ±.07 pounds. Adjustments to the test load to achieve the proper weight can be made by the use of energy stuffer cloths, with no more than five stuffer cloths per load. Dampen the load by agitating it in water whose temperature is 100°±5°F and consists of 0 to 17 parts per million hardness for approximately two minutes in order to saturate the fabric. Then, extract water from the wet test load by spinning the load until the moisture content of the load is between 66.5 percent to 73.5 percent of the bone-dry weight of the test load.

2.7.3 *Method of loading.* Load the energy test cloths by grasping them in the center, shaking them to hang loosely and then dropping them in the dryer at random.

2.8 *Clothes dryer preconditioning.* Before any test cycle, operate the dryer without a test load in the non-heat mode for 15 minutes or until the discharge air temperature is varying less than 1°F for 10 minutes, which ever is longer, in the test installation location with the ambient conditions within the specified rest condition tolerances of 2.2.

3. TEST PROCEDURES AND MEASUREMENTS

3.1 *Drum capacity.* Measure the drum capacity by sealing all openings in the drum except the loading port with a plastic bag, and ensure that all corners and depressions are filled and that there are no extrusions of the plastic bag through the opening in the drum. Support the dryer's rear drum surface on a platform scale to prevent deflection of the dryer, and record the weight of the empty dryer. Fill the drum with water to a level determined by the intersection of the door plane and the loading port. Record the temperature of the water and then the weight of the dryer with the added water and then determine the mass of the water in pounds. Add or subtract the appropriate volume depending on whether or not the plastic bag protrudes into the drum interior. The drum capacity is calculated as follows:

$C=w/d$

C=capacity in cubic feet.

w=weight of water in pounds.

d=density of water at the measured temperature in pounds per cubic feet.

3.2 *Dryer loading.* Load the dryer as specified in 2.7.

3.3 *Test cycle.* Operate the clothes dryer at the maximum temperature setting and, if equipped with a timer, at the maximum time setting and dry the test load until the moisture content of the test load is between 2.5 percent to 5.0 percent of the bone-dry weight of the test load, but do not permit the dryer to advance into cool down. If required, reset the timer or automatic dry control.

3.4 *Data recording.* Record for each test cycle:

3.4.1 Bone-dry weight of the test load described in 2.7.

3.4.2 Moisture content of the wet test load before the test, as described in 2.7.

3.4.3 Moisture content of the dry test load obtained after the test described in 3.3.

3.4.4 Test room conditions, temperature and percent relative humidity described in 2.2.

3.4.5 For electric dryers—the total kilowatt-hours of electric energy, E_t, consumed during the test described in 3.3.

3.4.6 For gas dryers:

3.4.6.1 Total kilowatt-hours of electrical energy, E_{te}, consumed during the test described in 3.3.

3.4.6.2 Cubic feet of gas per cycle, E_{tg}, consumed during the test described in 3.3.

3.4.6.3 On gas dryers using a continuously burning pilot light—the cubic feet of gas, E_{pg}, consumed by the gas pilot light in one hour.

3.4.6.4 Correct the gas heating value, GEF, as measured in 2.3.2.1 and 2.3.2.2, to standard pressure and temperature conditions in accordance with U.S. Bureau of Standards, circular C417, 1938. A sample calculation is illustrated in Appendix E of HLD-1.

3.5 *Test for automatic termination field use factor credits.* Credit for automatic termination can be claimed for those dryers which meet the requirements for either temperature-sensing control, 1.12, or moisture sensing control, 1.13, and having present the appropriate mark or detent feed defined in 1.11.

4. CALCULATION OF DERIVED RESULTS FROM TEST MEASUREMENTS

4.1 *Total per-cycle electric dryer energy consumption.* Calculate the total electric dryer energy consumption per cycle, E_{ce}, expressed in kilowatt-hours per cycle and defined as:

$E_{ce}=[66/W_w-W_d)]\times E_{tt}\times FU$

E_t=the energy recorded in 3.4.5.

66=an experimentally established value for the percent reduction in the moisture content of the test load during a laboratory test cycle expressed as a percent.

FU=Field use factor.

=1.18 for time termination control systems.

=1.04 for automatic control systems which meet the requirements of the definitions for automatic termination controls in 1.11.1, 1.12 and 1.13.

W_w=the moisture content of the wet test load as recorded in 3.4.2.

W_d=the moisture content of the dry test load as recorded in 3.4.3.

4.2 *Per-cycle gas dryer electrical energy consumption.* Calculate the gas dryer electrical energy consumption per cycle, E_{ge}, expressed in kilowatt-hours per cycle and defined as:

$E_{ge}=[66/(W_w-W_d)]\times E_{te}\times FU$

E_{te}=the energy recorded in 3.4.6.1

FU, 66, W_w, W_d as defined in 4.1

4.3 *Per-cycle gas dryer gas energy consumption.* Calculate the gas dryer gas energy consumption per cycle, E_{gg} expressed in Btu's per cycle as defined as:

$E_{gg}=[66/(W_w-W_d)]\times E_{tg}\times FU\times GEF$

E_{tg}=the energy recorded in 3.4.6.2

GEF=corrected gas heat value (Btu per cubic feet) as defined in 3.4.6.4

FU, 66, W_w W_d as defined in 4.1

4.4 *Per-cycle gas dryer continuously burning pilot light gas energy consumption.* Calculate the gas dryer continuously burning pilot light gas energy consumption per cycle, E_{up} expressed in Btu's per cycle and defined as:

$E_{up}=E_{pg}\times(8760-140/416)\times GEF$

E_{pg}=the energy recorded in 3.4.6.3

8760=number of hours in a year

416=representative average number of clothes dryer cycles in a year

140=estimated number of hours that the continuously burning pilot light is on during the operation of the clothes dryer for the representative average use cycle for clothes dryers (416 cycles per year)

GEF as defined in 4.3

4.5 *Total per-cycle gas dryer gas energy consumption expressed in Btu's.* Calculate the total gas dryer energy consumption per cycle, E_g, expressed in Btu's per cycle and defined as:

$E_g=E_{gg}+E_{up}$

E_{gg} as defined in 4.3

E_{up} as defined in 4.4

4.6 *Total per-cycle gas dryer energy consumption expressed in kilowatt-hours.* Calculate the total gas dryer energy consumption per cycle, E_{cg}, expressed in kilowatt-hours per cycle and defined as:

$E_{cg}=E_{ge}+(E_g/3412\ Btu/k\ Wh)$

E_{ge} as defined in 4.2

E_y as defined in 4.5

[46 FR 27326, May 19, 1981]

APPENDIX E TO SUBPART B OF PART 430—UNIFORM TEST METHOD FOR MEASURING THE ENERGY CONSUMPTION OF WATER HEATERS

1. Definitions

1.1. *Cut-in* means the time or water temperature when a water heater thermostat has acted to increase the energy or fuel input to the heating elements, compressor, or burner.

1.2. *Cut-out* means the time or water temperature when a water heater thermostat has acted to reduce to a minimum the energy or fuel input to the heating elements, compressor, or burners.

1.3. *Design Power Rating* means the nominal power rating that a water heater manufacturer assigns to a particular design of water heater, expressed in kilowatts or Btu per hour as appropriate.

1.4. *Energy Factor* means a measure of water heater overall efficiency.

1.5. *First Hour Rating* means the amount of hot water the water heater can supply in one hour of operation.

1.6. *Heat Trap* means a device which can be integrally connected, or independently attached, to the hot and/or cold water pipe connections of a water heater such that the device will develop a thermal or mechanical seal to minimize the recirculation of water due to thermal convection between the water heater tank and its connecting pipes.

1.7. *Recovery Efficiency* means the ratio of energy delivered to the water to the energy content of the fuel consumed by the water heater.

1.8. *Standby* means the time during which water is not being withdrawn from the water heater. There are two standby time intervals used within this test procedure: $\tau_{stby,1}$ represents the elapsed time between the time at which the maximum mean tank temperature is observed after the sixth draw and the end of the 24 hour test; $\tau_{stby,2}$ represents the total time during the 24 hour simulated use test when water was not being withdrawn from the water heater.

1.9. *Gas fueled storage water heater* means a water heater which utilizes gas as the energy source and which is designed to heat and store water at a thermostatically controlled temperature of less than 180 °F with an input of 75,000 Btu per hour or less and a manufacturers specified storage capacity of not less than 20 gallons nor more than 100 gallons.

1.10 *Electric storage water heater* means a water heater which utilizes electricity as the energy source and which is designed to heat and store water at a thermostatically controlled temperature of less than 180 °F with an input of 12 kilowatts or less and a manufacturers specified storage capacity of not less than 20 gallons nor more than 120 gallons.

1.11 *Oil storage water heater* means a water heater which utilizes oil as the energy source and which is designed to heat and store water at a thermostatically controlled temperature of less than 180 °F with an energy input of 105,000 Btu per hour or less, and which has a manufacturers specified storage capacity of 50 gallons or less.

1.12 *Gas fueled instantaneous water heater* means a water heater which utilizes gas as the energy source controlled manually or automatically by a water flow activated control or a combination of water flow and thermostatic control, which is designed to deliver water at a controlled temperature of less than 180 °F, and which has an input greater than 50,000 Btu per hour and less than 200,000 Btu per hour, and a manufacturers specified storage capacity of less than 2 gallons.

1.13 *Heat pump water heater* means a water heater which utilizes electricity as the energy source with a maximum current rating of 24 amperes at a voltage no greater than 250 volts, and which is designed to transfer thermal energy from one temperature level to a higher temperature level for the purpose of heating water, including all auxiliary equipment such as fans, storage tanks, pumps, or controls necessary for the device to perform its function.

1.14 *ASHRAE Standard 41.1-86* means the standard published in 1986 by the American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. and titled Standard Measurement Guide: Section on Temperature Measurements.

1.15. *ASTM-D-2156-80* means the test standard published in 1980 by the American Society of Testing and Measurements and titled Method for Smoke Density in Flue Gases from Burning Distillate Fuels.

1.16. "Rated Storage Volume" means the water storage capacity of a water heater, in gallons, as specified by the manufacturer.

2. Test Conditions

2.1. *Installation Requirements.* Tests shall be performed with the water heater and instrumentation installed in accordance with section 4.

2.2. *Ambient Air Temperature.* The ambient air temperature, shall be controlled to a value between 65.0 °F and 70.0 °F on a continuous basis. For heat pump water heaters maintain the dry bulb temperature at 67.5 ± 1 °F. Additionally, for heat pump water heaters the relative humidity shall be maintained between 49 and 51 percent.

2.3. *Supply Water Temperature.* The temperature of the water being supplied to the water heater shall be maintained at 58 ± 2 °F throughout the test.

2.4. *Storage Tank Temperature.* The average temperature of the water within the storage tank shall be set to 135 ± 5 °F.

2.5. *Supply Water Pressure.* During the test when water is not being withdrawn, the supply pressure shall be maintained between 40 psig and the maximum allowable pressure specified by the water heater manufacturer.

2.6. *Electrical and/or Fossil Fuel Supply.*

2.6.1. *Electrical.* Maintain the electrical supply voltage to within ± 1 percent of the center of the voltage range specified by the water heater and/or heat pump manufacturer.

2.6.2. *Natural Gas.* Maintain the supply pressure in accordance with the manufacturer's specifications. If the supply pressure is not specified, maintain a supply pressure of 7 to 10 inches of water column. If the water heater is equipped with a gas appliance pressure regulator, the regulator outlet pressure shall be within ± 10% of the manufacturer's specified manifold pressure. Use natural gas with a higher heating value of approximately 1,025 Btu per standard cubic foot.

2.6.3. *Propane Gas.* Maintain the supply pressure in accordance with the manufacturer's specifications. If the supply pressure is not specified, maintain a supply pressure of 11 to 13 inches of water column. If the water heater is equipped with a gas appliance pressure regulator, the regulator outlet pressure shall be within ± 10% of the manufacturer's specified manifold pressure. Use propane gas with a higher heating value of approximately 2,500 Btu per standard cubic foot.

2.6.4. *Fuel Oil Supply.* Maintain an uninterrupted supply of fuel oil. Use fuel oil with a heating value of approximately 138,700 Btu per gallon.

3. Instrumentation

3.1. *Pressure Measurements.* Pressure measuring instruments shall have an error no greater than the following values:

Item measured	Instrument accuracy	Instrument precision
Gas pressure	±0.1 inch of water column.	±0.05 inch of water column
Atmospheric pressure.	±0.1 inch of mercury column.	±0.05 inch of mercury column
Water pressure	±1.0 pounds per square inch.	±0.50 pounds per square inch

3.2. Temperature Measurement

3.2.1. *Measurement.* Temperature me urements shall be made in accordance wi the Standard Measurement Guide: Sec on Temperature Measurements, ASHR Standard 41.1-86.

3.2.2. *Accuracy and Precision.* The accu cy and precision of the instruments, inclu ing their associated readout devices, shall b within the limits as follows:

Item measured	Instrument accuracy	Instrume precis
Air dry bulb temperature	±0.2°F	±0.1
Air wet bulb temperature	±0.2°F	±0.1
Inlet and outlet water temperatures	±0.2°F	±0.1
Storage tank temperatures	±0.5°F	±0.2

3.2.3. *Scale Division.* In no case shall th smallest scale division of the instrument o instrument system exceed 2 times the spe fied precision.

3.2.4. *Temperature Difference.* Tempera ture difference between the entering a leaving water may be measured with any o the following:

a. A Thermopile
b. Calibrated resistance thermometers
c. Precision thermometers
d. Calibrated thermistors
e. Calibrated thermocouples
f. Quartz thermometers

3.2.5. *Thermopile Construction.* If a the mopile is used, it shall be made from ca brated thermocouple wire taken from single spool. Extension wires to the recor ing device shall also be made from th same spool.

3.2.6. *Time Constant.* The time consta of the instruments used to measure th inlet and outlet water temperatures shall b no greater than 5 seconds.

3.3 *Liquid Flow Measurements.* The accu racy of the liquid flow rate measuremen using the calibration if furnished, shall b equal to or less than ± 1% of the measur value in mass units per unit time.

3.4. *Electric Energy.* The electrical ener used shall be measured with an instrume and associated readout device that are accu rate within ± 1% of the reading.

3.5. *Fossil Fuels.* The quantity of fuel us by the water heater shall be measured wi an instrument and associated readout devi that is accurate within ± 1% of the readin

3.6. *Mass Measurements.* Mass measur ments shall be made measured with instr ments that are accurate within ± 1% of th reading or 0.1 lbm, whichever is greater.

3.7. *Heating Value.* The higher heati value of the natural gas, propane, or fuel o shall be measured with an instrument a associated readout device that is accura within ± 1% of the reading. The heating value of natural gas and propane must be corrected for local temperature and pressure conditions.

3.8. *Time.* The elapsed time measurements shall be measured with an instrument that is accurate within ± 0.5 seconds per hour.

4. Installation

4.1. *Water Heating Mounting.* A water heater designed to be free standing shall be installed according to the manufacturer's directions on a ¾ inch thick plywood platform supported by three 2 × 4 inch runners. If the water heater is not approved for installation on combustible flooring, suitable non-combustible material shall be placed between it and the platform. For heat pump water heaters without a storage tank supplied by the manufacturer, connections shall be made with a storage tank as described in section 4.9.3 and in accordance with manufacturer-published installation instructions. The storage tank and heat pump section shall be placed on platform(s) constructed as previously described. If installation materials are not provided by the heat pump manufacturer, use uninsulated 8 foot long connecting hoses, having an inside diameter of ⅝ inch. Wall mounted water heaters shall be installed in accordance with manufacturer-published installation instructions on a simulated wall section made from ¾ inch plywood and 2 × 4 inch studs. Placement in the test room shall be in an area protected from drafts.

4.2. *Water Supply.* The water supply shall be capable of delivering water at conditions as specified in section 2.

4.3. *Water Inlet and Outlet Configuration.* Inlet and outlet piping connections shall be configured as illustrated in Figures 1, 2, or 3 except a water heater 36 inches high or less, (commonly referred to as an under counter or table top model) intended for installation either beneath, adjacent to or in conjunction with a counter shall have the inlet and outlet connections configured as illustrated in Figures 4a and 4b. Type "L" hard copper tubing, the same size as the connections on the water heater shall be connected to the tank and extend 24 inches in length. If a water heater 36 inches high or less is not factory equipped with pipe to extend the field connection point of the water heater lines to outside of the jacket or cabinet, type "L" hard copper tubing shall be used to extend the water line horizontally to the exterior of the jacket or cabinet. Unions may be utilized to facilitate installation and removal of the piping arrangements. A pressure gauge and diaphragm expansion tank shall be installed in the supply water piping at a location upstream of the 24 inch cold water inlet pipe. An appropriately rated pressure and temperature relief valve shall be installed on all water heaters at the port specified by the manufacturer. Discharge piping for the relief valve shall be non-metallic. If heat traps and/or piping insulation and/or pressure relief valve insulation are supplied with the water heater, then they shall be installed for testing. Clearance shall be provided such that none of the piping contacts other surfaces in the test room.

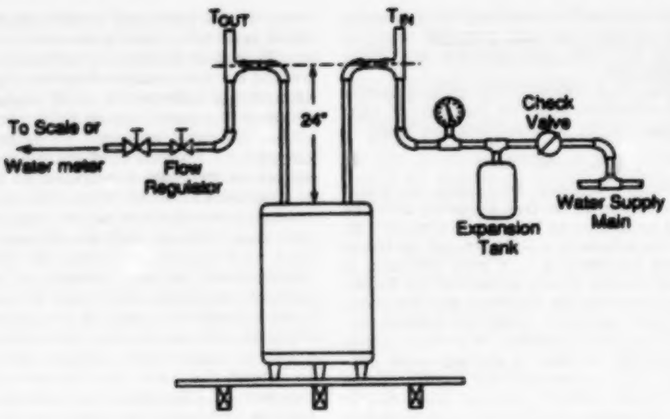
T_OUT
T_IN
24"
To Scale or
Water meter
Flow
Regulator
Check
Valve
Expansion
Tank
Water Supply
Main

Figure 1

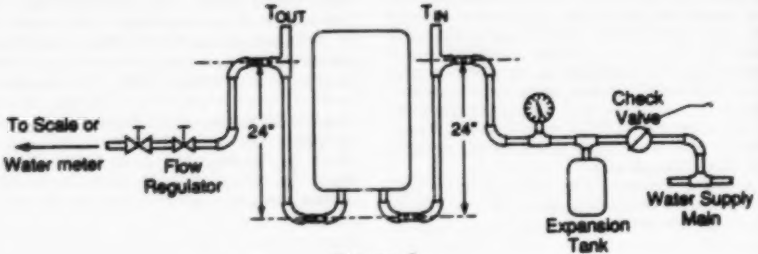
T_OUT
T_IN
To Scale or
Water meter
Flow
Regulator
24"
24"
Check
Valve
Expansion
Tank
Water Supply
Main

Figure 2

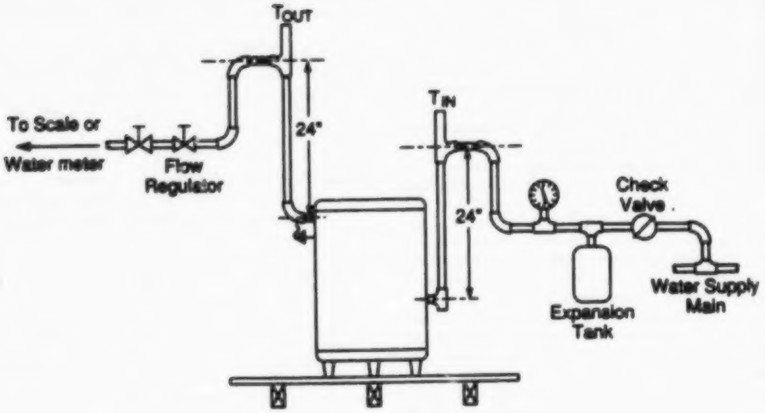
T_OUT
To Scale or
Water meter
Flow
Regulator
24"
T_IN
24"
Check
Valve
Expansion
Tank
Water Supply
Main

Figure 3

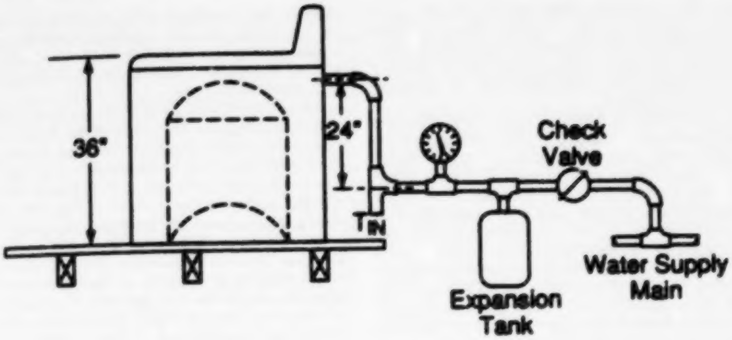
36"
24"
T_{IN}
Check Valve
Expansion Tank
Water Supply Main

Figure 4a.

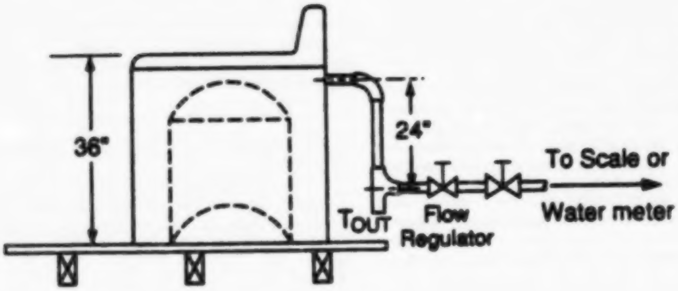
36"
24"
T_{OUT}
Flow Regulator
To Scale or Water meter

Figure 4b.

4.4. *Fuel and/or Electrical Power and Energy Consumption.* Install one or more instruments which measure, as appropriate, the quantity and rate of electrical energy and/or fossil fuel consumption in accordance with section 3.

4.5. *Internal Storage Tank Temperature Measurements.* Install six temperature measurement sensors inside the water heater tank with a vertical distance of at least four inches between successive sensors. A temperature sensor shall be positioned at the vertical midpoint of each of the six equal volume nodes with the tank. Nodes designate the equal volumes used to evenly partition the total volume of the tank. As much as is possible, the temperature sensor should be positioned away from any heating elements, anodic protective devices, tank walls, and flue pipe walls. If the tank cannot accommodate six temperature sensors and meet the installation requirements specified above, install the maximum number of sensors which comply with the installation requirements. The temperature sensors shall be installed either through; (1) The anodic device opening; (2) the relief valve opening; or (3) the hot water outlet. If installed through the relief valve opening or the hot water outlet, a tee fitting or outlet piping, as applicable, shall be installed as close as possible to its original location. If the hot water outlet includes a heat trap, the heat trap shall be installed on top of the tee fitting. Added fittings shall be covered with thermal insulation having an R value of 4 hr·ft²·°F/Btu.

4.6. *Ambient Temperature.* The ambient air temperature shall be measured approximately at the vertical mid-point of the heater and approximately 2 feet from the surface of the water heater. The sensor shall be shielded against radiation.

4.7. *Inlet and Outlet Water Temperature Measurements.* Install temperature sensors in the cold-water inlet pipe and hot-water outlet pipe as shown in Figures 1, 2, or 3, as applicable.

4.8. *Flow Control.* A flow control valve shall be installed to provide flow as specified within section 5.

4.9. *Flue Requirements.*

4.9.1. *Oil-Fired Water Heaters.* Establish a draft at the flue collar as specified in the manufacturer's literature. Establish the draft by using a sufficient length of vent pipe connected to the water heater flue outlet and directed vertically upward. For an oil-fired water heater having a horizontally discharging draft hood outlet, a 90 degree elbow having a diameter equal to the largest flue collar size of the draft hood shall be connected to the draft hood outlet. A length of vent pipe sufficient to establish the draft shall be connected to the elbow fitting and oriented to discharge vertically upward. Direct vent oil-fired water heaters should be installed with venting equipment as specified in the manufacturer's instructions, using the minimum vertical and horizontal lengths of vent pipe recommended by the manufacturer.

4.9.2. *Gas-Fired Water Heaters.* Establish a natural draft in the following manner. For gas-fired water heaters having a vertically discharging draft hood outlet, a 5 foot vertical vent pipe extension having a diameter equal to the largest flue collar size of the draft hood shall be connected to the draft hood outlet. For gas-fired water heaters having a horizontally discharging draft hood outlet, a 90 degree elbow having a diameter equal to the largest flue collar size of the draft hood shall be connected to the draft hood outlet. A 5 foot length of vent pipe shall be connected to the elbow and oriented to discharge vertically upward.

Direct vent gas-fired water heaters shall be installed wth venting equipment specified in the manufacturer's instructions using the minimum vertical and horizontal lengths of vent pipe recommended by the manufacturer.

4.9.3. *Heat Pump Water Heater Storage Tank.* The tank to be used for testing a heat pump water heater without a tank supplied by the manufacturer shall be an electric storage type water heater having a volume of 47.0 gallons ± 1 gallon with an Energy Factor of 0.87 ± .01 as determined in accordance with section 6.1.7 with two 4.5 kW heating elements controlled in such a manner as to prevent both elements from operating simultaneously.

5. Test Procedures

5.1. *Storage Tank and Heat Pump Water Heaters.*

5.1.1. *Determination of Storage Tank Volume.* Determine the storage capacity, V_s, of the water heater under test, in gallons, by subtracting the tare weight—measured while the tank is empty—from the gross weight of the storage tank completely filled with water with all air eliminated and line pressure applied as described in section 2.5 and dividing the resulting net weight by the density of water at the appropriate temperature.

5.1.2. *Setting the Thermostat for a Thermostatically Operated Water Heater.* Starting with a tank of supply water, initiate normal operation of the water heater. After cutout, observe the mean tank temperature (based on the six temperature sensors) every minute until the maximum value is observed. Determine whether this maximum value of the mean tank temperature is within the range of 135°F ±5°F. If not, turn off the water heater, adjust the thermostat, and refill the tank with supply water. Then, initiate normal operation of the water heater, and once again determine the maximum mean tank temperature after cut-out. Repeat this sequence until the maximum mean tank temperature after cut-out is within the range of 135°F ±5°F. If a water heater has two thermostats, the thermostat which controls the upper heating element shall be set first to yield a maximum water temperature of 135°F ±5°F as measured by the temperature tank sensors above the upper heating element. The thermostat which controls the lower heating element shall then be set to yield a maximum mean tank temperature of 135°F ±5°F. For heat pump water heaters, which control an auxiliary resistance element, the thermostat shall be set in accordance with the manufacturer's installation instructions.

5.1.3. *Power Input Determination.* For all water heaters except electric types having immersed heating elements and initiate normal operation and determine the power input, P, to the main burners (including pilot light power, if any) after 15 minutes of operation. If the water heater is equipped with a gas appliance pressure regulator, the regulator outlet pressure shall be set within ±10% of that recommended by the manufacturer. For oil fired water heaters the fuel pump pressure shall be within ±10% of the manufacturer's specified pump pressure. All burners shall be adjusted to achieve an hourly Btu rating that is within ±2% of the value specified by the manufacturer. For an oil-fired water heater, adjust the burner to give a CO_2 reading recommended by the manufacturer and an hourly Btu rating that is within ±2% of that specified by the manufacturer. Smoke in the flue may not exceed No. 1 smoke as measured by the procedure in ASTM-D-2156-80. Gas- and oil-fired water instantaneous water heaters shall have the burners adjusted to the manufacture's maximum firing rate value.

5.1.4. *First Hour Rating Test.* Establish normal water heater operation with the maximum mean tank temperature within the range specified in section 2.1.4. Begin the first hour rating test after the thermostat has acted to reduce the electrical power or fuel input to the water heater and the maximum storage tank temperature has been achieved. If the water heater incorporates a heat-pump, wait until both the heat pump and electrical heating element(s) have ceased to supply energy to the storage tank. Record the time, oil, gas and/or electrical meter readings as appropriate. Do not interrupt electrical power and/or fuel to the water heater. The rate of water withdrawal shall be 3.00±0.25 gallons per minute. Draw and collect water withdrawn from the water heater in a suitable container for the purpose of determining its weight at the conclusion of the test. During the draw record the inlet and outlet fluid temperature beginning 15 seconds after the start and at every subsequent 5 second interval throughout the duration of each draw. Alternatively, a water meter may be used to directly measure the volume of water withdrawn. Record the maximum outlet temperature which occurs during the draw as T_{max}. The withdrawal of water shall continue until the outlet temperature drops to a value 25°F below T_{max}, defined as T_{min}, at which time the draw shall be terminated. Record the average outlet temperature and mass removed as $T_{del,i}$ and M_i, respectively. If the thermostat acts to reduce the supply of fuel to the main burner or electrical input to the upper heating element of a multiple element electric water heater, or electrical input to a water heater having a single element or multiple elements which operate simultaneously, before one hour has elapsed, initiate a second draw. During the draw record the outlet fluid temperatures beginning 15 seconds after initiating the draw and at every subsequent 5 second interval throughout the duration of each draw until the outlet temperature drops to T_{min}, at which time the draw is terminated. Record the average outlet temperatures as well as the mass removed. Continue this sequence of events until one hour has elapsed. If a draw is currently taking place, continue the draw until the outlet temperature reaches T_{min}, and record the elasped time between the previously recorded time, at the beginning of the first draw, and the termination of this final draw as $_{fhr}$. If a draw is not taking place at the end of one hour, wait until the thermostat acts to reduce the supply of fuel to the main burner or electrical input to the upper heating element of a multiple element electric water heater, or electrical input to a water heater having a single element or multiple elements which operate simultaneously, to initiate the final draw. During the final draw, record the outlet fluid temperature beginning 15 seconds after initiating the draw and at every subsequent 5 second intervals throughout the duration of the draw until the outlet temperature drops to T_{min}, at which time the draw is terminated. Record the elasped time between the previously recorded time, at the beginning of the first draw, and the termination of the final draw as $_{fhr}$. In either case, record the outlet temperatures and the mass removed during the final draw.

5.1.5. *24 Hour Simulated Use Test.* During the simulated use test, a total of 64.3 gallons are removed. With the water heater turned off, fill the water heater with supply water and apply pressure as described in section 2.1.5. Turn on the water heater and associated heat pump unit, if present. Wait until cutout occurs at 135°F ±5°F, as specified in section 2.1.4. After the cutout occurs, measure the mean tank temperature using the temperature sensors described in section 4.5

every minute until the maximum mean storage tank temperature is achieved. The water heater may be operated through up to three successive cycles of drawing 10 gallons per draw, permitting recovery between each draw, prior to the start of the test. Record at this time (designated as $\tau=0$), the mean tank temperature ($\bar{T}_0$), and the oil, gas, and electrical energy measurements as appropriate. Begin the 24 hour simulated use test by drawing an amount of water out of the water heater equivalent to one-sixth of the daily hot water usage, 64.3 gallons. Record the average storage tank and ambient temperature every 15 minutes throughout the 24 hour simulated use test unless recovery or a draw is occurring. At elapsed time intervals of one, two, three, four and five hours from $\tau=0$), initiate additional draws removing an amount of water equivalent to one-sixth of 64.3 gallons, with the maximum allowable deviation for any single draw being ±0.5 gallons. The quantity of water drawn during the sixth draw shall be increased or decreased as necessary such that the total volume of water withdrawn shall be equal to 64.3±1.0 gallons.

All draws during the simulated use test are to be made at flow rates of 3.0±3.0 gallons per minute. Measurements of the inlet and outlet temperatures shall be made beginning 15 seconds after the draw is initiated and at every subsequent 5 second interval throughout the duration of each draw. The arithmetic mean of the hot water discharge temperature and the cold water inlet temperature shall be determined for each draw. Record the scale or meter reading, as appropriate, after each draw. At the end of the recovery period following the first draw, record the maximum mean tank temperature observed after cut-out, $T_{max,1}$, and the energy consumed, Q_r, for oil, gas, and heat pump water heaters including auxiliary energy such as pilot lights, pumps, fans, etc. For heat pump water heaters Q_r, is the sum of the energy consumed by the heat pump and the electrical heating elements(s).

At the end of the recovery period following the sixth draw, record the total electric and/or fuel energy consumption, Q_{su}, and the scale reading or the meter reading, as appropriate. If a water scale is used, determine the net weight of the water withdrawn, M_{FHR} in pounds. Record the maximum value of the mean tank temperature after cutout as $\bar{T}_{su}$. Except as noted below, allow the water heater to remain in the standby mode until 24 hours have elapsed from the start of the test, $\tau=0$. Prevent the water heater from beginning a recovery cycle during the last hour of the test by turning off the electric power to the electrical heating elements and heat pump, if present, or by turning down the fuel supply to the main burner at an elapsed time of 23 hours. If a recovery is taking place at an elapsed time of 23 hours, wait until the recovery is complete before reducing the electrical and/or fuel supply to the water heater. At 24 hours, record the mean tank temperature, $\bar{T}_{24}$, and the electric and/or fuel instrument readings. Determine the total energy consumption during the entire 24 hour simulated use test, Q. Record the time interval between the time at which the maximum mean tank temperature is observed after the sixth draw and the end of the 24 hour test as $\tau_{stby,1}$. Record the time during which water was not being withdrawn from the water heater during the entire 24 hour period as $\tau_{stby,2}$.

5.2 Instantaneous Water Heaters

5.2.1. *Setting the Outlet Discharge Temperature.* Initiate normal operation of the water heater at the full input rating. Monitor the discharge water temperature and set to a value of 135°F ± 5°F in accordance with the manufacturer's instructions. If the water heater is not capable of providing 3.00 ± 0.25 gallons per minute then adjust the flow rate as necessary to achieve the specified discharge water temperature. Record the corresponding flow rate as V_{max}. If the instantaneous water heater incorporates a controller which permits continous burner operation at a reduced input rate, adjust the flow rate as necessary to achieve a discharge water temperature of 135° ± 5°F while maintaining the minimum input rate. Record the corresponding flow rate, V_{min}. If an outlet temperature of 135° ± 5°F cannot be achieved at the minimum allowable flow rate permitted by the instantaneous water heater, record the flow rate as V_{min} and the outlet temperature as T_{min}.

5.2.2. *Power Input Determination.* For oil and gas flow actuated water heaters, adjust the burners to the maximum firing rate value specified by the manufacturer.

5.2.3. *First Hour Rating Test for Instantaneous Water Heaters.* Establish normal heater operation at the maximum input rate with the discharge water temperature set in accordance with section 5.2.1. Record the time, oil, and/or gas meters as appropriate. Do not interrupt electrical or fuel to the water heater. Draw and collect water withdrawn from the water heater, while recording the inlet and outlet fluid temperatures beginning 15 seconds after the draw is initiated and at every subsequent 5 second interval throughout the duration of the draw in a suitable container for the purpose of determining its weight at the conclusion of the test. Alternatively, a water meter may be used to directly measure the value of water withdrawn. At the end of one hour terminate the draw. Determine the mass of water withdrawn, M_{FHR}, in pounds, or the volume of water withdrawn, V_{FHR}, in gallons with an error no greater than 2 percent.

5.2.4. 24 Hour Simulated Use Test

5.2.4.1. *Fixed Input Instantaneous Water Heaters.* Establish normal operation with the discharge water temperature and flow rate set to values of 135°F ± 5°F and V_{max}, respectively. Record the oil, gas, and electrical energy measurements, as appropriate. Begin the 24 hour simulated use test by drawing an amount of water out of the water heater equivalent to one-sixth of the daily not water usage, 64.3 gallons. At elapsed time intervals of one, two, three, four, and five hours from $\tau=0$, initiate additional draws removing an amount of water equivalent to one-sixth of 64.3 gallons, with the maximum allowable deviation for any single draw being ± 0.5 gallons. The quantity of water drawn during the sixth draw shall be increased or decreased as necessary such that the total volume of water withdrawn shall be equal to 64.3±1.0 gallons. Measurements of the inlet and outlet water temperatures shall be made beginning 15 seconds after the draw is initiated and at every 5 second interval throughout the duration of the draw. The arithmetic mean of the hot water discharge temperature and the cold water inlet temperature shall be determined for each draw. Record the scale or meter reading, as appropriate, after each draw. At the end of the recovery period following the first draw, record the energy consumed, Q_r. Allow the water heater to remain in the standby mode until exactly 24 hours have elapsed from the start of the test, $\tau=0$. At 24 hours, record the electric and/or fuel instrument readings. Determine the energy consumption during the entire 24 hour simulated use test, Q.

5.2.4.2. *Variable Input Instantaneous Water Heaters.* If the instantaneous water heater incorporates a controller which permits continuous burner operation at a reduced input rate, the first three draws shall be conducted using the maximum flow rate, V_{max}, while removing an amount of water equivalent to one-sixth of 64.3 gallons, with the maximum allowable deviation for any one of the three draws being ± 0.5 gallons. The second three draws shall be conducted at V_{min}. If an outlet temperature of 135° ± 5°F could not be achieved at the minimum flow rate permitted by the instantaneous water heater, the last three draws should be lengthened such that the volume removed is equivalent to

$$V_{4,5,6} = \frac{64.3}{6} \bullet \left[\frac{77°F}{T_{min}-58°F} \right]$$

with the maximun allowable definition for any one of the three draws being ± 0.5 gallons. The quantity of water drawn during the sixth draw shall be increased or decreased as necessary such that the total volume of water withdrawn shall be equal to $32.15 + 3^{*}V_{4,5,6} \pm 1.0$ gallons. Measurements of the inlet and outlet water temperatures shall be made beginning 15 seconds after the draw is initiated and at every 5 second interval throughout the duration of the draw. Determine the arithmetic mean of the hot water discharge temperature and the cold water inlet temperature for each draw. Record the scale or meter reading, as appropriate, after each draw. At the end of the recovery period following the first draw, record the energy consumption, $Q_{r,\ max}$. Record the energy consumed prior to the fourth draw and at the end of the recovery period following the fourth draw, $Q_{r,\ min}$.

Allow the water heater to remain in the standby mode until exactly 24 hours have elapsed from the start of the test, $\tau=0$. At 24 hours, record the electric and/or fuel instrument readings. Determine the energy consumption during the entire 24 hours simulated use test, Q.

6. Computations

6.1 *Storage Tank Water Heaters.*

6.1.1. *Storage Tank Capacity.* The storage tank capacity is computed using the following—

$$V_{st}=(W_f-W_t)/\rho$$

where V_{st} is the storage capacity of the water heater, gallons

W_f is the weight of the storage tank completely filled with water, lbm

W_t is the tare weight of the empty storage tank, lbm

ρ is the density of water at the appropriate temperature, lbm/gal.

6.1.2. First Hour Rating Computation. Compute the first hour rating as

$$F_{hr} = \frac{60}{\tau_{fhr}} \sum_{i=1}^{n} \frac{M_i(T_{del,\ i}-T_{in,i})}{\rho(135°F-58°F)}$$

Which may be expressed as

$$F_{hr} = \frac{60}{\tau_{fhr}} \sum_{i=1}^{n} \frac{M_i(T_{del,\ i}-T_{in,i})}{\rho(77°F)}$$

where M_i represents the mass removed during the ith draw of the first hour rating test, lbm

$T_{del,\ i}$ is the average delivery temperature for the ith draw which occurred during the first hour rating test, °F

τ_{fhr} represents the elapsed time recorded during the first hour rating test, minutes

$\hat{T}_{in,i}$ is the average inlet temperature for the ith draw which occurred during the first hour rating test, °F

ρ represents the density of water at the average delivery temperature, lbm/gal

and n represents the number of draws which occur during the test If a water meter is used in lieu of a scale, the first hour rating is

$$F_{hr} = \frac{60}{\tau_{fhr}} \sum_{i=1}^{n} \frac{V_i(T_{del,i} - T_{in,i})}{77°F}$$

where V_i represents the volume removed during the ith draw of the first hour rating test, gal

6.1.3 *Recovery Efficiency.* The recovery efficiency for gas, oil, and heat pump storage type water heaters is computed as

$$\eta_r = \frac{M_1 C_{p1}(\hat{T}_{del,1} - \hat{T}_{in,1})}{Q_r}$$

$$+ \frac{V_{st} \rho C_{p2}(T_{max,1} - \hat{T}_o)}{Q_r}$$

where M_1 is the mass withdrawn during the first draw, lbm

C_{p1} is the specific heat of water at the average temperature $(\hat{T}_{del,1} + T_{in,1})/2$, btu/lbm °F

$\hat{T}_{del,1}$ is the average delivery temperature for the first draw, °F

$\hat{T}_{in,1}$ is the average inlet temperature for the first draw, °F

V_{st} is the storage tank capacity, gal

ρ is the density of water at the average temperature $(T_{max,1} + \hat{T}_o)/2$, lbm/gal

C_{p2} is the specific heat of water at the average temperature $(T_{max,1} + \hat{T}_o)/2$, Btu/lbm °F

$T_{max,1}$ is the maximum mean tank temperature recorded after cutout following the first draw, °F

$\hat{T}_o$ is the maximum mean tank temperature recorded prior to the first draw, °F

and Q_r is the total energy used by the water heater between cutout prior to the first draw and cutout following the first draw, including auxiliary energy such as pilot lights, pumps, fans, etc., Btu. (Electrical auxiliary energy shall be converted to thermal energy using the following conversion: 1kWh = 3412.76 Btu.)

The recovery efficiency for electric water heaters with immersed heating elements is assumed to be 98 percent.

6.1.4. *Hourly Standby Losses.* The hourly standby losses are computed as

$$Q_{hr} = \left[Q_{stby} - \frac{MC_p(\hat{T}_{24} - \hat{T}_{su})}{\eta_r} \right] \Big/ \tau_{stby}$$

where Q_{hr} is the hourly standby energy losses of the water heater, Btu/hr

Q_{stby} is the total energy consumer by the water heater between the time at which the maximum mean tank temperature is observed after the sixth draw and the end of the 24 hour test period, Btu

M is the mass of the water within the storage tank, lbm

C_p is the specific heat of water at the average temperature $(\hat{T}_{24} + \hat{T}_{su})/2$, Btu/lbm °F

$\hat{T}_{24}$ is the mean tank temperature at the end of the 24 hour test period, °F

$\hat{T}_{su}$ is the maximum mean tank temperature observed after the sixth draw, °F

and $\tau_{stby,1}$ is the elapsed time between the time at which the maximum mean tank temperature is observed after the sixth draw and the end of the 24 hour test period, hours

The standby heat loss coefficient for the tank is compu'ed as—

$$UA = \frac{Q_{hr}}{\hat{T}_{t,stby} - \hat{T}_{a,stby}}$$

where $\hat{T}_{t,stby}$ is the average storage tank temperature between the time at which the maximum mean tank temperature is observed after the sixth draw and the end of the 24 hour test period, °F

$\hat{T}_{a,stby}$ is the average ambient temperature between the time at which the maximum mean tank temperature is observed after the sixth draw and the end of the 24 hour test period, °F

and UA is the standby heat loss coefficient of the storage tank,

$$\frac{\text{BTU}}{\text{hr °F}}$$

6.1.5. *Daily Water Heating Energy Consumption.* The daily water heating energy consumption, Q_d is computed as

$$Q_d = Q - \frac{C_p M(\bar{T}_{24} - \bar{T}_o)}{\eta_r}$$

where Q is the total energy used by the water heater during the 24 hours simulated use test including auxiliary energy such as pilot lights, pumps, fans, etc., Btu

C_p is the specific heat of water at the average temperature $(\bar{T}_{24}+\bar{T}_o)/2$, Btu/lbm °F

M is the mass of water within the storge tank, lbm

$\bar{T}_{24}$ is the average tank temperature at the conclusion of the 24 hours simulated use test, °F

$\bar{T}_o$ is the average tank temperature at the beginning of the 24 hours simulated use test, recorded one minute before the first draw is initiated °F

and η_r is the recovery efficiency of the hot water heater, dimensionless.

6.1.6. *Adjusted Daily Water Heating Energy Consumption.* The adjusted daily water heating energy consumption, Q_{da} takes into account that the temperature difference between the storage tank and surrounding ambient temperature may not be the nominal value of 67.5°F (135°F − 67.5°F) due to the 10°F allowable variation in storage tank temperature, 135 ± 5°F, and the 5°F allowable variation in surrounding ambient temperature 65°F to 70°F. The adjusted daily water heating energy consumption is computed as

$$Q_{da} = Q_d - [(\bar{T}_{stby} - \bar{T}_{a,stby}] - (135°F - 67.5°F)]UA\tau_{stby,2}$$

where Q_{da} is the adjusted daily water heating consumption, Btu

$\bar{T}_{stby}$ is the mean tank temperature during the total standby portion, $\tau_{stby,2}$, of the 24 hour test, °F

$\bar{T}_{a,stby}$ is the average ambient temperature during the total standby portion, $\tau_{stby,2}$, of the 24 hour test, °F

UA is the standby heat loss coefficient for the storage tank, Btu/hr°F

and $\tau_{stby,2}$ is the number of hours during the 24 hour simulated test when water was not being withdrawn from the water heater

A modification is also needed to take into account that the temperature difference between the outlet water temperature and supply water temperature may not be equivalent to the nominal value of 77°F (135°F−58°F). The following equations adjust the experimental data to a nominal 77°F temperature rise.

The energy used to heat water, Btu per day, may be computed as—

$$Q_{HW} = \sum_{i=1}^{6} \frac{M_i C_{pi}(\bar{T}_{del,i} - T_{in,i})}{\eta_r}$$

where M_i is the mass withdrawn for the ith draw (i=1 to 6), lbm

C_{pi} is the specific heat of water, Btu/lbm °F

The energy required to heat the same quantity of water over a 77 °F temperature rise, Btu per day, is

$$Q_{HW,77} = \sum_{i=1}^{6} \frac{M_i C_{pi}(135°F - 58°F)}{\eta_r}$$

The difference between these two values is—

$$Q_{HWD} = Q_{HW,77} - Q_{HW}$$

which must be added to the adjusted daily water heating energy consumption value. Thus, the daily energy consumption value which takes into account that the temperature difference between the storage tank and ambient temperature may not be 67.5°F and the temperature rise across the storage tank may not be 77°F is—

$$Q_{dm} = Q_{da} + Q_{HWD}$$

6.1.7. *Energy Factor.* The energy factor, E_f, is computed as—

$$E_f = \sum_{i=1}^{6} \frac{M_i C_{pi}(135°F - 58°F)}{Q_{dm}}$$

where Q_{dm} is the modified daily water heating energy consumption as computed in accordance with Section 6.1.6, Btu

6.1.8. Annual Energy Consumption

The annual energy consumption for storage type and heat pump water heaters is computed as—

$$E_{annual} = Q_{dm} * 365$$

where Q_{dm} is the modified daily energy consumption value, Btu per day and 365 is the number of days within a year, days

6.2. Instantaneous Hot Water Heaters.

6.2.1. *First Hour Rating Computation.* Compute the first hour rating as

$$F_{hr} = \frac{M(\bar{T}_{del} - \bar{T}_{in})}{\rho(135°F - 58°F)}$$

which may be expressed as—

$$F_{hr} = \frac{M(\bar{T}_{del} - \bar{T}_{in})}{\rho(77°F)}$$

where M represents the mass removed during the one hour continuous draw, lbm

$\bar{T}_{del}$ is the average delivery temperature, °F

$\bar{T}_{in}$ is the average inlet temperature, °F

and ρ represents the density of water at the average delivery temperature, lbm/gal

If a water meter is used in lieu of a scale the first hour rating is computed as—

$$F_{hr} = \frac{V(\bar{T}_{del} - \bar{T}_{in})}{77°F}$$

where V represents the volume of water removed during the one hour continuous draw, gal

6.2.2. Recovery Efficiency

6.2.2.1. *Fixed Input Instantaneous Water Heaters.* The recovery efficiency is computed as

$$\eta_r = \frac{M_1 C_{p1}(\bar{T}_{del,1} - \bar{T}_{in,1})}{Q_r}$$

where M_1 is the mass withdrawn during the first draw, lbm

C_{p1} is the specific heat of water at the average temperature $(\bar{T}_{del,1} + \bar{T}_{in,1})/2$, Btu/lbm°F

$\bar{T}_{del,1}$ is the average delivery temperature for the first draw, °F

$\bar{T}_{in,1}$ is the average inlet temperature for the first draw, °F

and Q_r is the total energy used by the water heater between cutout prior to the first draw and cutout following the first draw, including auxiliary energy such as pilot lights, pumps, fans, etc., Btu

6.2.2.2. Variable Input Instantaneous Water Heaters

For instantaneous water heaters which have a variable firing rate, two recovery efficiency values are computed, one at the maximum input rate and one at the minimum input rate. The recovery efficiency used in subsequent computations is taken as the average of these two values. The maximum recovery efficiency is computed as

$$\eta_{r,max} = \frac{M_1 C_{p1}(\bar{T}_{del,1} - \bar{T}_{in,1})}{Q_{r,max}}$$

where M_1 is the mass withdrawn during the first draw, lbm

C_{p1} is the specific heat of water at the average temperature $(\bar{T}_{del,1} + \bar{T}_{in,1})/2$, Btu/lbm °F

$\bar{T}_{del,1}$ is the average delivery temperature for the first draw, °F

$\bar{T}_{in,1}$ is the average inlet temperature for the first draw, °F

and $Q_{r,max}$ is the total energy used by the water heater between cutout prior to the first draw and cutout following the first draw, including auxiliary energy such as pilot light, Btu

The minimum recovery efficiency is computed as—

$$\eta_{r,min} = \frac{M_4 C_{p4}(\bar{T}_{del,4} - \bar{T}_{in,4})}{Q_{r,min}}$$

where M_4 is the mass withdrawn during the fourth draw, lbm

C_{p4} is the specific heat of water, Btu/lbm °F

$\bar{T}_{del,4}$ is the average delivery temperature for the fourth draw, °F

$\bar{T}_{in,4}$ is the average inlet temperature for the first draw, °F

and $Q_{r,min}$ is the total energy consumed immediately prior to the fourth draw and cutout following the fourth draw, including auxiliary energy such as pilot lights, Btu

The recovery efficiency is computed as—

$$\eta_r = \frac{\eta_{r,max} + \eta_{r,min}}{2}$$

6.2.3. *Daily Water Heating Energy Consumption.* The daily water heating energy consumption, Q_d is computed as—

$$Q_d = Q$$

where Q is the energy used by the flow actuated water heater during the 24 hour simulated use test

A modification is needed to take into account that the temperature difference between the outlet water temperature and supply water temperature may not be equivalent to the nominal value of 77 °F (135 °F−58 °F). The following equations adjust the experimental data to a nominal 77 °F temperature rise.

The energy used to heat water may be computed as—

$$Q_{HW} = \sum_{i=1}^{6} \frac{M_i C_{pi}(T_{del,i} - T_{in,i})}{\eta_r}$$

The energy required to heat the same quantity of water over a 77 °F temperature rise is—

$$Q_{HW,77} = \sum_{i=1}^{6} \frac{M_i C_{pi}(135\,^\circ F - 58\,^\circ F)}{\eta_r}$$

The difference between these two values is—

$$Q_{HWD} = Q_{HW,77} - Q_{HW}$$

which must be added to the daily water heating energy consumption value. Thus, the daily energy consumption value which takes into account that the temperature rise across the storage tank may not be 77 °F is—

$$Q_{dm} = Q_d + Q_{HWD}$$

6.2.4. *Energy Factor.* The energy factor, E_f, is computed as—

$$E_f = \sum_{i=1}^{6} \frac{M_i C_{pi}(135\,^\circ F - 58\,^\circ F)}{Q_{dm}}$$

where Q_{dm} is the daily water heating energy consumption as computed in accordance with section 6.2.3., Btu

M_i is the mass associated with the ith draw, lbm

C_{pi} is the specific heat of water computed at a temperature of (58 °F+135 °F)/2, Btu/lbm °F

$T_{del,i}$ is the average delivery temperature for the ith draw, °F

and $T_{in,i}$ is the average inlet temperature for the ith draw, °F

6.2.5. *Annual Energy Consumption.* The annual energy consumption for instantaneous type water heaters is computed as—

$$E_{annual} = Q_{dm} * 365$$

where Q_{dm} is the modified daily energy consumption, Btu per day

and 365 is the number of days within a year, days.

7. Ratings for Untested Models

In order to relieve the test burden to manufacturers who offer water heaters which differ only in fuel type or power input, ratings for untested models may be established in accordance with the following procedures. In lieu of the following procedures a manufacturer may elect to test the unit for which a rating is sought.

7.1. *Gas Water Heaters.* Ratings obtained for gas water heaters using natural gas can be used for an identical water heater which utilizes propane gas if the input ratings are within 10 percent.

7.2. Electric Water Heaters

7.2.1. *First Hour Rating.* If an electric storage type water heater is available with more than one input rating, the manufacturer shall designate the standard input rating and the water heater need only be tested with heating elements at the designated standard input ratings. The first hour ratings for units having power input rating less than the designated standard input rating shall be assigned a first hour rating equivalent to the first draw of the first hour rating for the electric water heater with the standard input rating. For units having power inputs greater than the designated standard input rating, the first hour rating shall be equivalent to that measured for the water heater with the standard input rating.

7.2.2. *Energy Factor.* The energy factor for identical electric storage type water heaters, with the exception of heating element wattage, may use the energy factor obtained during testing of the water heater with the designated standard input rating.

[55 FR 42169, Oct. 17, 1990]

EFFECTIVE DATE NOTE: At 55 FR 42169, Oct. 17, 1990, part 430 was amended by revising appendix E to subpart B, effective April 15, 1991. For the convenience of the user, the superseded text appears below.

APPENDIX E TO SUBPART B OF PART 430—UNIFORM TEST METHOD FOR MEASURING THE ENERGY CONSUMPTION OF WATER HEATERS

1. DEFINITIONS

1.1 "Cutout" means the moment in time when a water heater thermostat has acted to reduce the energy or fuel input to the heating elements or burners to a minimum.

1.2 "Design Power Rating" means the nominal power rating that a water heater manufacturer assigns to a particular design of water heater heating element, expressed in kilowatts.

1.3 "Heat Trap" means a device which can be integrally connected, or independently attached, to the hot or cold water pipe connections of a water heater such that the device will develop a thermal or mechanical seal to minimize the recirculation of water due to natural thermal convection between the water heater tank and its water supply pipes and thereby reduce the heat loss to the environment from the hot water stored in the water heater.

1.4 "Recovery Efficiency" means the ratio of the heat imparted to the water to—

(a) in the case of an electric water heater, the energy input to the heating elements during the period that the water temperature is raised from the inlet temperature to the final temperature with the tank filled to capacity.

(b) in the case of a gas or oil water heater, the heat content of the fuel consumed by the burners during the period that the water temperature is raised from the inlet temperature to the final temperature with the tank filled to capacity.

1.5 "Standby loss" means the ratio of the heat loss per hour to the heat content of the stored water above room temperature.

2. TEST CONDITIONS

2.1 *Installation.* Install the water heater according to the manufacturer's directions on a ¾-inch-thick plywood platform supported by three 2 x 4-inch runners. For water heaters without integral heat traps and with vertical inlet and outlet pipe connections, install the inlet and outlet piping with heat traps at the inlet and outlet ports. Such heat traps may be made using pipe fittings such as elbows connected in such a fashion that the inlet and outlet piping make vertically upward runs just before turning downward to connect to the inlet and outlet ports. For water heaters with integral heat traps or with horizontal inlet and outlet pipe connections, install the inlet and outlet piping in any convenient fashion.

Sufficient clearance shall be allowed between the water heater surface and the piping (including heat traps, if any) so that when the piping is insulated as specified below, the insulation does not contact any water heater surface except at the location where the pipe connections penetrate the water heater jacket. Insulate the water heater inlet and outlet piping (including heat traps, if any) for a length of four feet from the connection at the water heater with a material having a thermal resistance (R) value of not less than

$$4^{\circ}\ \mathrm{F/Btu/ft^{2}hr}$$

2.2 *Flue requirements for gas and oil water heaters.*

2.2.1 *Flue requirements for gas water heaters.* For a gas water heater having a vertically discharging draft hood outlet, a 5 foot vertical flue pipe extension having a diameter equal to the largest flue collar size of the draft hood shall be connected to the draft hood outlet. For a gas water heater having a horizontally discharging draft hood outlet, a 90 degree elbow having a diameter equal to the largest flue collar size of the draft hood shall be connected to the draft hood outlet. A 5 foot length of flue pipe shall be connected to the elbow and oriented to discharge vertically upward. Perform all tests with the natural draft established by this length of flue pipe. Direct vent gas water heaters should be installed with venting equipment as specified in the manufacturer's instructions; however, the vertical length of the flue pipe shall be no greater than 5 feet.

2.2.2 *Flue requirements for oil water heaters.* For an oil fueled water heater, establish a draft at the flue collar equivalent to at least 0.02 inch of water column during periods of burner firing. For an oil water heater having a vertically discharging draft hood outlet, establish the draft by using a sufficient length of flue pipe connected to the water heater flue outlet and directed vertically upward. For an oil water heater having a horizontally discharging draft hood outlet, a 90 degree elbow having a diameter equal to the largest flue collar size of the draft hood shall be connected to the draft hood outlet. A length of flue pipe sufficient to establish the draft shall be connected to the elbow fitting and oriented to discharge vertically upward. Direct vent oil water heaters should be installed with venting equipment as specified in the manufacturer's instructions. When ceiling height limits the use of a sufficient length of vertical flue pipe for an oil water heater, a mechanical draft inducer may be used during periods of burner firing to establish the specified draft at the flue collar.

2.3 *Water supply.* During the entire test maintain the water supply to the water heater inlet at a temperature of between 68 and 72° F., and at a gauge pressure of between 40 pounds per square inch and the maximum pressure specified by the manufacturer for the water heater under test. If the water supply pressure varies outside of these limits during testing, the heater shall be isolated by use of a shut-off valve in the supply line with an expansion tank installed in the supply line downstream of the shut-off valve. There shall be no shut-off means between the expansion tank and the water heater inlet.

2.4 *Energy Supply.*

2.4.1 *Electrical supply.* For an electric water heater and for the auxiliary electrical system, if any, of an oil or gas water heater, maintain the electrical supply voltage to within ±1 percent of the center of the voltage range specified by the water heater manufacturer on the water heater nameplate throughout the entire operating portion of each test.

2.4.2 *Gas supply.*

2.4.2.2 *Natural gas.* For a gas water heater utilizing natural gas, maintian the gas supply at a normal inlet test pressure immediately ahead of all controls at 7 to 10 inches of water column. If the water heater is equipped with a gas appliance pressure regulator, the regulator outlet pressure at the normal test pressure shall be approximately that recommended by the manufacturer. All burners shall be adjusted to achieve an hourly Btu rating that is within ±2 percent of the hourly Btu rating specified by the manufacturer. Use natural gas with a higher heating value of approximately 1,025 Btu per standard cubic foot. Determine the actual higher heating value, H_n, in Btu per standard cubic foot, for the natural gas to be used in the test, with an error no greater than ±1 percent, and use that value for all calculations included herein. Alternatively, the test can be conducted using "bottled" natural gas of a higher heating value of approximately 1,025 Btu per standard cubic foot as long as the actual higher heating value of the bottled natural gas has been determined with an error no greater than ±1 percent as certified by the supplier.

2.4.2.2 *Propane gas.* For a gas water heater utilizing propane, maintain the gas supply at a normal inlet test pressure immediately ahead of all controls at 11 to 13 inches of water column. If the water heater is equipped with a gas appliance pressure regulator, the regulator outlet pressure at normal test pressure shall be approximately that recommended by the manufacturer. All burners shall be adjusted to achieve an hourly Btu rating that is within ±2 percent of the hourly Btu rating specified by the manufacturer. Use propane with a higher heating value of approximately 2,500 Btu per standard cubic foot. Determine the actual higher heating value, H_p, in Btu per standard cubic foot, for the propane to be used in the test, with an error no greater than ±1 percent, and use that value for all calculations included herein. Alternatively, the test can be conducted using "bottled" propane of a higher heating value of approximately 2,500 Btu per standard cubic foot as long as the actual higher heating value of the bottled propane has been determined with an error no greater than ±1 percent as certified by the supplier.

2.4.3 *Oil supply.* For an oil water heater utilizing fuel oil, maintain an uninterrupted supply of fuel oil to the water heater during the entire operating portion of the test cycle. Use fuel oil with a heating value of approximately 138,500 Btu per gallon. Determine the actual heating value, H_o, in Btu per gallon for the fuel oil to be used in the test with an error no greater than ±1 percent, and use that value for all calculations included herein. Alternatively, the tests can be conducted using a tested fuel oil with a certified higher heating value of approximately 138,500 Btu per gallon as long as the actual higher heating value of the test fuel oil has been determined with an error of no greater than ±1 percent as certified by the supplier.

2.5 *Thermocouple installation.* Install six thermocouples inside the water heater tank. Position each thermocouple measuring junction along a vertical line at the level of the center horizontal plane of each of six non-overlapping sections of approximately equal volume from the top to the bottom of the tank such that each thermocouple is surrounded by water and as far as possible from any heating element, anodic protective device, or a water tank or flue wall. The anodic protective device may be removed in order to install the thermocouples and all testing may be carried out with the device removed. Install thermocouples in both the cold-water inlet pipe and the hot-water outlet pipe not more than six inches from the connections to the water heater, or where those connections are inaccessible, at the closest accessible point to those connections. Install in the test room a thermocouple with junction shielded against direct radiation from the water heater and positioned at the vertical mid-point of the heater at a perpendicular distance of approximately 24 inches from the surface of the water heater jacket. Provide an associated temperature measurement and indicator system to assure that the temperature indicated for the thermocouple location is within ±1° F. of the actual temperature at that location.

2.6 *Setting the tank thermostat.* Starting with a tank of unheated water, initiate normal operation of the water heater. After cutout, determine whether the maximum value of the mean tank temperature is within the range of 160° F. ±5° F. if not, turn off the water heater, adjust the thermostat, empty the tank and refill with unheated water, then initiate normal operation of the water heater, and once again determine the maximum mean tank temperature after cutout. Repeat this sequence until the maximum mean tank temperature after cutout is within the range of 160° F. ±5°F., at which time the thermostat is properly set. If a water heater has two thermostats, the thermostat which controls the upper heating element shall be set first to yield a maximum water temperature of 160° F. ±5° F. as measured by the topmost tank thermocouple after cutout. The thermostat which controls the lower heating element shall then be set to yield a maximum mean tank temperature of 160° F. ±5° F. after cutout.

2.7 *Fuel or energy consumption measurement.* Install one or more instruments which measure, as appropriate, and with an error no greater than ±1 percent, the quantity of electrical energy, natural gas, propane or fuel oil consumed by a water heater. Electrical energy consumption is to be expressed in units of kilowatt-hours. Natural gas and propane consumption shall be expressed in units of standard cubic feet, i.e., measured cubic feet corrected to standard conditions of 60° F. temperature and 30 inches of mercury column pressure. Fuel oil consumption is to be expressed in units of gallons. Also install one or more instruments which measure, as appropriate, and with an error no greater than ±1 percent, the rate of electrical energy, natural gas, propane or fuel oil consumption by a water heater. The rate of electrical energy consumption shall be expressed in units of kilowatts. The rate of natural gas and propane consumption shall be expressed in units of standard cubic feet per hour. The rate of fuel oil consumption shall be expressed in units of gallons per hour.

2.8 *Room ambient temperature.* Maintain the ambient air temperature of the test room between 65° F. and 85° F. at all times during the test, as measured according to section 3.5. The ambient air temperature during these tests shall not vary more than ±7° F. from the average ambient air temperature determined as the arithmetic average of the air temperatures measured periodically at intervals no greater than 15 minutes throughout the duration of the test.

3. TEST PROCEDURES AND MEASUREMENTS

3.1 *Tank storage capacity.* Determine the storage capacity, V, of the water heater under test, in gallons, according to the method specified in section 2.26 of the American National Standard for Gas Water Heaters, Volume I, designated ANS Z21.10.1-1975.

3.2 *Power input determination.*

3.2.1 *Power input determination for gas and oil water heaters and electric water heaters with other than immersed heating elements.* Initiate normal operation of the water heater, and by using the appropriate instrumentation specified in section 2.7 and the appropriate fuel heating values of section 2.4, determine the power input, *P*, to the main burners (including pilot light power, if any) or heating elements of the water heater under test, in Btu per hour or kilowatts, as appropriate. In addition, determine the power input, p_e to any auxiliary electrical system of a gas or oil water heater when the main burners are in operation, in kilowatts; and the power input, p_s, to any auxiliary electrical system of a gas or oil water heater when the main burners are not in operation, in kilowatts.

3.2.2 *Power input determination for electric water heaters with immersed heating elements.* The power input, *P*, to the heating element of an electric water heater with one immersed heating element shall be taken to be the design power rating of the heating element. For an electric water heater with dual immersed heating elements, the power input, *P*, to the heating elements shall be taken to be the arithmetic mean of the design power ratings of the heating elements, if, in characteristic operation of the water heater, only one heating element will be energized at any time; otherwise, *P* shall be taken to be the sum of the design power ratings of the heating elements.

3.3 *Recovery efficiency.*

3.3.1 *Recovery efficiency for gas and oil water heaters and electric water heaters with other than immersed heating elements.* With the water heater turned off, fill the tank with water and eliminate any residual air remaining in the tank. If the mean tank temperature is constant and within 70° F.±2° F., record the mean tank temperature, initiate normal operation of the water heater, and begin measuring the fuel or energy flow to the burners (including pilot light fuel if any) or heating elements of the water heater using the appropriate instrumentation specified in section 2.7 After cutout determine the maximum mean tank temperature and record the total fuel flow, Q_r, for a gas or oil water heater, or the total electrical energy flow, Z_r, to the heating elements of an electric water heater, from initiation to cutout. Record the temperature difference, ΔT_1, obtained by subtracting the initial from the final maximum mean tank temperature.

3.3.2 *Recovery efficiency for electric water heaters with immersed heating elements.* The recovery efficiency for electric water heaters with immersed heating elements is derived from the results of the standby loss tests of section 3.4.2.

3.4 *Standby loss.*

3.4.1 *Standby loss for gas and oil water heaters and electric water heaters with other than immersed heating elements.* Establish normal water heater operation within the maximum mean tank temperature within the range specified in section 2.6 and with all air eliminated from the tank. Begin the standby loss test immediately after cutout. At the beginning of the standby loss test record the time, the mean tank temperature, the ambient air temperature, and begin measuring the fuel or energy flow to the burners (including pilot light fuel if any) or heating elements of the water heater using the appropriate instrumentation specified in section 2.7.

At the end of the first 15 minute interval and at the end of each subsequent 15 minute interval following the beginning of the test, record the mean tank temperature and the ambient air temperature. Continue these measurements until the end of a 48 hour period unless a main heating element or burner is on at that time, in which case, continue these measurements until the first subsequent cutout. When the test is terminated, record the total fuel flow, Q_s, for a gas or oil water heater, or the total electrical energy flow, Z_r, to the heating elements of an electric water heater, from the beginning to the end of the test period, the final mean tank temperature, the final ambient air temperature, and the time duration, *t*, of the standby loss test, in hours rounded off to the nearest tenth of an hour, which elapsed from the beginning to the end of the test period. Calculate the average of the recorded values of the mean tank temperatures and of the ambient air temperatures taken at the end of each time interval, including in each case the initial and final values. Determine the difference, ΔI, between these two averages by subtracting the latter from the former, and the difference, ΔL, between the final and initial mean tank temperatures by subtracting the latter from the former.

3.4.2 *Standby loss for electric water heaters with immersed heating elements.* All water heaters to be tested must be equipped with immersed heating elements that have a design power rating of 4,500 watts unless such a design power rating exceeds the maximum design power rating specified by the manufacturer for the water heater to be tested, in which case the standby loss test will be conducted with the water heater equipped with immersed heating elements of a design power rating equal to the manufacturer's specified maximum design power rating. All water heaters capable of operating with dual immersed heating elements will be equipped and tested with dual immersed heating elements of equal design power rating in accordance with the provisions specified above. Tests shall be conducted in accordance with the same procedures as those specified in section 3.4.1.

3.5 *Room temperature measurement.* Room temperature wherever specified shall be the temperature determined by using the test room thermocouple described in section 2.5.

3.6 *Mean tank temperature measurement.* Mean tank temperature, the average temperature of the water in a water heater tank, whever specified shall be the mean of the temperatures determined by using the six water heater tank thermocouples described in section 2.5.

3.7 *First hour rating water draw test.* Establish normal water heater operation with the maximum mean tank temperature within the range specified in section 2.6 and with all air eliminated from the tank. Begin the first hour rating water draw test immediately after a cutout by recording the hot water outlet water temperature, recording the time, and withdrawing water from the water heater through the hot water outlet at a rate of 5.0±0.25 gallons per minute. Interrupt electrical power to the heating elements or fuel to the main burner of the water heater to prevent their operation during this test. Collect all of the water withdrawn from the water heater during the test in a suitable container for the purpose of determining its weight at the conclusion of the test. Alternatively, a water flow meter may be used to measure the volume of water withdrawn from the water heater directly. Beginning 15 seconds after the start of the test and at every subsequent 15 second interval throughout the duration of the water draw, record the outlet water temperature. For the purposes of this test, the maximum recorded temperature shall be referred to as the initial outlet water temperature, T_o. Monitor the functioning of the water heater thermostats and record the time that a thermostat on the water heater acts to operate a heating element or the main burner. Continue the withdrawal of water until the outlet water temperature drops to a value 20°F below the initial water temperature, at which time terminate the withdrawal. Determine the weight of the water withdrawn, W, in pounds measured with an error no greater than 2 percent, or the volume of water withdrawn, G, in gallons measured with an error no greater than 2 percent. Determine the arithmetic mean of the outlet water temperature readings recorded, T_m, in °F. Determine the elapsed time of the test prior to a thermostat on the water heater acting to operate a heating element or the main burner, t_c, in hours measured with an error no greater than 2 percent. If a thermostat on the water heater does not act to operate a heating element or the main burner within one hour after the start of the test, the test is to be terminated and t_c expressed as one hour.

4. CALCULATION OF DERIVED RESULTS FROM TEST MEASUREMENTS

4.1 *Recovery efficiency.*

4.1.1 *Recovery efficiency for gas and oil water heaters.* For a gas or oil water heater, calculate the recovery efficiency, E_r, expressed as a dimensionless quantity and defined as:

$$E_r=(k\times V\times \Delta T_1/Q_r\times H),$$

where

k=8.25 Btu per gallon °F., the nominal specific heat of water.

V=tank capacity, determined in accordance with section 3.1, expressed in gallons.

ΔT_1=difference between the initial and final mean tank temperatures, determined in accordance with section 3.3.1, expressed in °F.

Q_r=total fuel flow in the recovery test, determined in accordance with section 3.3.1, expressed in appropriate units.

H=higher heating value for the appropriate fuel type, H_n, H_p, or H_o, as determined in accordance with section 2.4, expressed in appropriate units.

4.1.2 *Recovery efficiency for electric water heaters with other than immersed heating elements.* For an electric water heater with other than immersed heating elements, calculate the recovery efficiency, E_r, expressed as a dimensionless quantity and defined as:

$$E_r=(k\times V\times \Delta T_1/Z_r\times 3{,}412\ \text{Btu/kWh}),$$

where

k, V, and ΔT_1 are as defined in section 4.1.1

Z_r=total electrical energy flow to the heating elements in the recovery test, determined in accordance with section 3.3.1, expressed in kilowatt-hours.

4.1.3 *Recovery efficiency for electric water heaters with immersed heating elements.* For an electric water heater with immersed heating elements, calculate the recovery efficiency, E_r, expressed as a dimensionless quantity and defined as:

$$E_r=1-(S\times k\times V\times \Delta T_2/P\times 3{,}412\ \text{Btu/kWh}),$$

where

k and V are as defined in section 4.1.1

S=standby loss, as calculated in section 4.4.2.

ΔT_2=45° F., the nominal average difference between the mean tank temperature and the ambient air temperature during recovery.

P=water heater input power, determined in accordance with section 3.2.2, expressed in kilowatts.

4.2 Standby loss.

4.2.1 *Standby loss for gas and oil water heaters.* For a gas or oil water heater, calculate the standby loss, expressed in hour^{-1} and defined as:

$$S=(Q_s\times H/k\times V\times \Delta T_3\times t)-(\Delta T_4/\Delta T_3\times t\times E_r)$$

where

k, V, and H are as defined in section 4.1.1

E_r is as calculated in section 4.1.1

Q_s=total fuel flow in the standby loss test, determined in accordance with section 3.4.1, expressed in appropriate units.

ΔT^3=difference between the average value of the mean tank temperature and the average value of the ambient air temperature during the standby loss test, determined in accordance with section 3.4.1, expressed in ° F.

ΔT_4=difference between the initial and final mean tank temperatures, determined in accordance with section 3.4. expressed in ° F.

t=duration of the standby loss test, dete mined in accordance with section 3.4. expressed in hours.

4.2.2 *Standby loss for electric water he ers.* For an electric water heater, calcula the standby loss, S, expressed in hour - and defined as:

$$S=(Z_s\times 3{,}412\ \text{Btu/kWh}/k\times V\times \Delta T_3\times t)-(\Delta T_4/\Delta T_3\times t\times E_r)^*$$

where

k and V are as defined in section 4.1.1.

Z_s=total electrical energy flow to th heating elements in the standby lo test, determined in accordance wi section 3.4.1 for electric water heate with other than immersed heating el ments, or section 3.4.2 for electr water heaters with immersed heatin elements, expressed in kilowatt-hou

ΔT_3=difference between the average valu of the mean tank temperature and th average value of the ambient air te perature during the standby loss te determined in accordance with sectio 3.4.1 for electric water heaters wi other than immersed heating el ments, or section 3.4.2 for electr water heaters with immersed heatin elements, expressed in kilowatt-hou

ΔT_4=difference between the initial an final mean tank temperatures, dete mined in accordance with section 3.4 for electric water heaters with othe than immersed heating elements, o section 3.4.2 for electric water heate with immersed heating elements, e pressed in kilowatt-hours.

t=duration of the standby loss test, dete mined in accordance with section 3.4 for electric water heaters with othe than immersed heating elements, o section 3.4.2 for electric water heate with immersed heating elements, e pressed in hours.

$E_r^*=E_r$ as calculated in section 4.1.2 fo electric water heaters with other tha immersed heating elements, or 0.98 fo electric water heaters with immers heating elements.

4.3 *Daily water heating energy consum tion.* Calculate the daily water heati energy consumption, C_{est}, the energy r quired to heat the nominal amount of h water used daily, expressed in Btu per d and defined as:

$$C_{est}=(k\times U\times \Delta T_1/E_r),$$

where

k is as defined in section 4.1.1.

E_r is as calculated in section 4.1.1 for g and oil water heaters, section 4.1.2 fo electric water heaters with other th immersed heating elements, or section 4.1.3 for electric water heaters with immersed heating elements.

ΔT_5=90° F., the nominal difference between the water heater inlet and outlet water temperatures.

U=64.3 gallons per day, the nominal daily hot water usage.

4.4 *Average hourly hot water storage energy consumption.* Calculate the average hourly hot water storage energy consumption, c_{ss}, the average energy required per hour to maintain stored water temperature, expressed in Btu per hour and defined as:

$$c_{ss}=S\times k\times V\times \Delta T_4,$$

where

k and V are as defined in section 4.1.1.

S is as calculated in section 4.2.1 for gas and oil water heaters, or section 4.2.2 for electric water heaters.

ΔT_4=90° F., the nominal difference between the mean tank temperature and the ambient air temperature.

4.5 *Average daily energy consumption.*

4.5.1 *Average daily auxiliary electric energy consumption for gas and oil water heaters.* For a gas or oil water heater, calculate the average daily auxiliary electrical energy consumption, C_{aux}, expressed kilowatt-hours per day and defined as:

$$C_{aux}=p_r\times(C_{wh}/P)+p_s\times[24\text{ (hours/day)}-(C_{wh}/P)]$$

where

C_{wh} is as calculated in section 4.3.

P=power input to the burner, determined in accordance with section 3.2.1, expressed in Btu per hour.

p_r=power input to any auxiliary electrical system during periods of main burner operation, determined in accordance with section 3.2.1, expressed in kilowatts.

p_s=power input to any auxiliary electrical system during periods when the main burner is not in operation, determined in accordance with section 3.2.1, expressed in kilowatts.

4.5.2 *Average daily gas or oil energy consumption for gas and oil water heaters.* For a gas or oil water heater, calculate the average daily gas or oil energy consumption, C_f, as appropriate, expressed in Btu per day and defined as:

$$C_f=C_{wh}+c_{ss}\times(24\text{ hours/day}-C_{wh}/P)-J_h-J_c,$$

where

C_{wh} is as calculated in section 4.3.

c_{ss} is as calculated in section 4.4.

P is as defined in section 4.5.1.

J_h=daily energy credit for a heat trap installed in the outlet water connection of a water heater=1,311 Btu per day for water heaters that have such a heat trap as an integral part of the water heater, or zero for water heaters that do not.

J_c=daily energy credit for a heat trap installed in the inlet water connection of a water heater = 983 Btu per day for water heaters that have such a heat trap as an integral part of the water heater, or zero for water heaters that do not.

4.5.3 *Average daily energy consumption for gas and oil water heaters.* For a gas or oil water heater, calculate the average daily energy consumption, C_s, expressed in Btu per day and defined as:

$$C_s=C_f+C_{aux}\times 3{,}412\text{ Btu/kWh},$$

where

C_f is as calculated in section 4.5.2.

C_{aux} is as calculated in section 4.5.1.

4.5.4 *Average daily energy consumption for electric water heaters.* For an electric water heater, calculate the average daily energy consumption, C_y, expressed in kilowatt-hours per day and defined as:

$$C_y=1/3{,}412\text{Btu/kWh}\times[C_{wh}+c_{ss}\times(24\text{ hours/day}-C_{wh}/\text{P}\times 3{,}412\text{Btu/kWh})-J_h-J_c]$$

where

C_{wh} is as calculated in section 4.3.

c_{ss} is as calculated in section 4.4.

J_h and J_c are as defined in section 4.5.2.

P=input power, determined in accordance with section 3.2.1 for electric water heaters with other than immersed heating elements or section 3.2.2 for electric water heaters with immersed heating elements, expressed in kilowatts.

4.6 *Daily hot water energy consumption.* Calculate the daily hot water energy consumption, C_r, the energy content of the nominal daily hot water usage, expressed in Btu per day and defined as:

$$C_r=k\times U\times \Delta T_5,$$

Where:

k is as defined in section 4.1.1; and

ΔT_5 and U are as defined in section 4.3.

4.7 *Recovery rate.*

4.7.1 *Recovery rate for gas and oil water heaters.* For a gas or oil water heater, calculate the recovery rate, R, expressed in gallons per hour and defined as:

$$R = \frac{P\cdot x\ Er}{k\ x\ \Delta T_5}$$

where—

k is as defined in section 4.1.1.

ΔT_5 is as defined in section 4.3.
E_r is as calculated in section 4.1.1.
P=power input to the burner, determined in accordance with section 3.2.1, expressed in Btu per hour.

4.7.2 *Recovery rate for electric water heaters.* For an electric water heater, calculate the recovery rate, R, expressed in gallons per hour and defined as:

$$R = \frac{P^* \times E_r \times 3{,}412 \text{ Btu/kWh}}{k \times \Delta T_5}$$

where—

k is as defined in section 4.1.1.
ΔT_5 is as defined in section 4.3.
E_r is as calculated in section 4.1.2 for electric water heaters with other than immersed heating elements, or section 4.1.3 for electric water heaters with immersed heating elements.
P^*=P, power input to the heating elements, expressed in kilowatts, determined in accordance with section 3.2.1 for electric water heaters with other than immersed heating elements or section 3.2.2 for electric water heaters with immersed heating elements, with the following exception: For electric water heaters with dual immersed heating elements which, in characteristic operation of the water heater, are not energized simultaneously at any time, P^* shall be taken as the design power rating of the heating element in closest proximity to the hot water outlet of the water heater, expressed in kilowatts.

4.8 *First hour rating.*

4.8.1 *Method for determining first hour rating.* Except as provided in section 4.8.2 first hour rating shall be determined in accordance with section 4.8.3.

4.8.2 *Options for determining first hour rating.* Until December 1, 1979, first hour rating may be determined in accordance with either section 4.8.3 or section 4.8.4.

4.8.3 *First hour rating determined by testing.* Calculate the first hour rating, F, expressed in gallons and defined as:

$$F = \left(\frac{W}{d} \times \frac{T_m}{T_o}\right) + \left[R \times (1 - t_c)\right], \text{ or}$$

$$F = \left(G \times \frac{T_m}{T_o}\right) + \left[R \times (1 - t_c)\right]$$

where—

R is as calculated in section 4.7.1 for gas and oil water heaters, or section 4.7.2 for electric water heaters.
W=weight of the water withdrawn from the water heater during the first hour rating water draw test, determined in accordance with section 3.7, expressed in pounds.

d=8.25 pounds per gallon, the nominal density of water.

G=volume of water withdrawn from the water heater during the first hour rating water draw test, determined in accordance with section 3.7, expressed gallons.

T_m=arithmetic mean of the outlet water temperature readings recorded during the first hour rating water draw test, determined in accordance with section 3.7, expressed in °F.

T_o=initial outlet water temperature recorded during the first hour rating water draw test, determined in accordance with section 3.7, expressed in °F.

t_r=elapsed time of the first hour rating water draw test prior to a thermostat on the water heater acting to operate a heating element or the main burner, determined in accordance with section 3.7, expressed in hours.

4.8.4 *First hour rating determined by calculation.* Calculate the first hour rating, F, expressed in gallons and defined as:

$$F = (0.85 \times V) + \left\{ R \times \left[1 \text{ hour} - \left(0.0028 \frac{\text{hour}}{\text{gallon}} \times V \right) \right] \right\}$$

where—

V is as defined in section 4.1.1.

R is as calculated in section 4.7.1 for gas and oil water heaters, or section 4.7.2 for electric water heaters.

0.85=the constant multiplier for calculating the results of the first hour rating water draw test.

0.0028 hour/gallon=the constant multiplier for calculating the duration of the water draw during the first hour rating water draw test, determined by dividing 0.85, as defined in this section, by the product of the hot water withdrawal rate during the first hour rating water draw test, five gallons per minute, and the conversion factor, 60 minutes per hour.

[42 FR 54117, Oct. 4, 1977, as amended at 43 FR 48987, Oct. 19, 1978. Redesignated and amended at 44 FR 37938, June 29, 1979; 44 FR 52639, Sept. 7, 1979]

APPENDIX F TO SUBPART B OF PART 430—UNIFORM TEST METHOD FOR MEASURING THE ENERGY CONSUMPTION OF ROOM AIR CONDITIONERS

1. *Test method.* The test method for testing room air conditioners shall consist of application of the methods and conditions in American National Standard (ANS) Z234.1-1972, "Room Air Conditioners," sections 4, 5, 6.1, and 6.5, and in American Society of Heating, Refrigerating and Air Conditioning in Engineers (ASHRAE) Standard 16-69, "Method of Testing for Rating Room Air Conditioners."

2. *Test conditions.* Establish the test conditions described in sections 4 and 5 of ANS Z234.1-1972 and in accordance with ASHRAE Standard 16-69.

3. *Measurements.* Measure the quantities delineated in section 5 of ANS Z234.1-1972.

4. *Calculations.* 4.1 Calculate the cooling capacity (expressed in Btu/hr) as required in section 6.1 of ANS Z234.1-1972 and in accordance with ASHRAE Standard 16-69.

4.2 Determine the electrical power input (expressed in watts) as required by section 6.5 of ANS Z234.1-1972 and in accordance with ASHRAE Standard 16-69.

[42 FR 27898, June 1, 1977. Redesignated and amended at 44 FR 37938, June 29, 1979]

APPENDIX G TO SUBPART B OF PART 430—UNIFORM TEST METHOD FOR MEASURING THE ENERGY CONSUMPTION OF UNVENTED HOME HEATING EQUIPMENT

1. Testing conditions.

1.1 *Installation.*

1.1.1 *Electric heater.* Install heater according to manufacturer's instructions. Heaters shall be connected to an electrical supply circuit of nameplate voltage with a wattmeter installed in the circuit. The wattmeter shall have a maximum error not greater than one percent.

1.1.2 *Unvented gas heater.* Install heater according to manufacturer's instructions. Heaters shall be connected to a gas supply line with a gas displacement meter installed between the supply line and the heater according to manufacturer's specifications. The gas displacement meter shall have a maximum error not greater than one percent. Gas heaters with electrical auxiliaries shall be connected to an electrical supply circuit of nameplate voltage with a wattmeter installed in the circuit. The wattmeter shall have a maximum error not greater than one percent.

1.1.3 *Unvented oil heater.* Install heater according to manufacturer's instructions. Oil heaters with electric auxiliaries shall be connected to an electrical supply circuit of nameplate voltage with a wattmeter installed in the circuit. The wattmeter shall have a maximum error not greater than one percent.

1.2 *Temperature regulating controls.* All temperature regulating controls shall be shorted out of the circuit or adjusted so that they will not operate during the test period.

1.3 *Fan controls.* All fan controls shall be set at the highest fan speed setting.

1.4 *Energy supply.*

1.4.1 *Electrical supply.* Supply power to the heater within one percent of the nameplate voltage.

1.4.2 *Natural gas supply.* For an unvented gas heater utilizing natural gas, maintain the gas supply to the heater with a normal inlet test pressure immediately ahead of all controls at 7 to 10 inches of water column. The regulator outlet pressure at normal supply test pressure shall be approximately that recommended by the manufacturer. The natural gas supplied should have a higher heating value within ± 5 percent of 1,025 Btu's per standard cubic foot. Determine the higher heating value, in Btu's per standard cubic foot, for the natural gas to be used in the test, with an error no greater than one percent. Alternatively, the test can be conducted using "bottled" natural gas of a higher heating value within ± 5 percent of 1,025 Btu's per standard cubic foot as long as the actual higher heating value of the bottled natural gas has been determined with an error no greater than one percent as certified by the supplier.

1.4.3 *Propane gas supply.* For an unvented gas heater utilizing propane, maintain the gas supply to the heater with a normal inlet test pressure immediately ahead of all controls at 11 to 13 inches of water column. The regulator outlet pressure at normal supply test pressure shall be that recommended by the manufacturer. The propane supplied should have a higher heating value of within± 5 percent of 2,500 Btu's per standard cubic foot. Determine the higher heating value in Btu's per standard foot, for the propane to be used in the test, with an error no greater than one percent. Alternatively, the test can be conducted using "bottled" propane of a higher heating value within ± 5 percent of 2,500 Btu's per standard cubic foot as long as the actual higher heating value of the bottled propane has been determined with an error no greater than one percent as certified by the supplier.

1.4.4 *Oil supply.* For an unvented oil heater utilizing kerosene, determine the higher heating value in Btu's per gallon with an error no greater than one percent. Alternatively, the test can be conducted using a tested fuel of a higher heating value within ± 5 percent of 137,400 Btu's per gallon as long as the actual higher heating value of the tested fuel has been determined with an error no greater than one percent as certified by the supplier.

1.5 *Energy flow instrumentation.* Install one or more energy flow instruments which measure, as appropriate and with an error no greater than one percent, the quantity of electrical energy, natural gas, propane gas, or oil supplied to the heater.

2. Testing and measurements.

2.1 *Electric power measurement.* Establish the test conditions set forth in section 1 of this appendix. Allow an electric heater to warm up for at least five minutes before recording the maximum electric power measurement from the wattmeter. Record the maximum electric power (P_E) expressed in kilowatts.

Allow the auxiliary electrical system of a forced air unvented gas, propane, or oil heater to operate for at least five minutes before recording the maximum auxiliary electric power measurement from the wattmeter. Record the maximum auxiliary electric power (P_A) expressed in kilowatts.

2.2 *Natural gas, propane, and oil measurement.* Establish the test conditions as set forth in section 1 of this appendix. A natural gas, propane, or oil heater shall be operated for one hour. Using either the nameplate rating or the energy flow instrumentation set forth in section 1.5 of this appendix and the fuel supply rating set forth in sections 1.4.2, 1.4.3, or 1.4.4 of this appendix, as appropriate, determine the maximum fuel input (P_F) of the heater under test in Btu's per hour. The energy flow instrumentation shall measure the maximum fuel input with an error no greater than one percent.

3. Calculations.

3.1 *Annual energy consumption for primary electric heaters.* For primary electric heaters, calculate the annual energy consumption (E_E) expressed in kilowatt-hours per year and defined as:

$E_E = 2080(0.77)DHR$

where:

2080 = national average annual heating load hours
0.77 = adjustment factor
DHR = design heating requirement and is equal to $P_E/1.2$ in kilowatts.
P_E = as defined in 2.1 of this appendix
1.2 = typical oversizing factor for primary electric heaters

3.2 *Annual energy consumption for primary electric heaters by geographic region of the United States.* For primary electric heaters, calculate the annual energy consumption by geographic region of the United States (E_R) expressed in kilowatt-hours per year and defined as:

E_R=HLH(0.77) (DHR)

where:

HLH=heating load hours for a specific region determined from Figure 1 of this appendix in hours
0.77=as defined in 3.1 of this appendix
DHR=as defined in 3.1 of this appendix

3.3 *Rated output for electric heaters.* Calculate the rated output (Q_{out}) for electric heaters, expressed in Btu's per hour, and defined as:

$Q_{out}=P_E$ (3,412 Btu/kWh)

where:

P_E=as defined in 2.1 of this appendix

3.4 *Rated output for unvented heaters using either natural gas, propane, or oil.* For unvented heaters using either natural gas, propane, or oil equipped without auxiliary electrical systems, the rated output (Q_{out}), expressed in Btu's per hour, is equal to P_Y, as determined in section 2.2 of this appendix.

For unvented heaters using either natural gas, propane, or oil equipped with auxiliary electrical systems, calculate the rated output (Q_{out}), expressed in Btu's per hour, and defined as:

$Q_{out}=P_Y+P_A$ (3,412 Btu/kWh)

where:

P_Y=as defined in 2.2 of this appendix in Btu/hr
P_A=as defined in 2.1 of this appendix in Btu/hr

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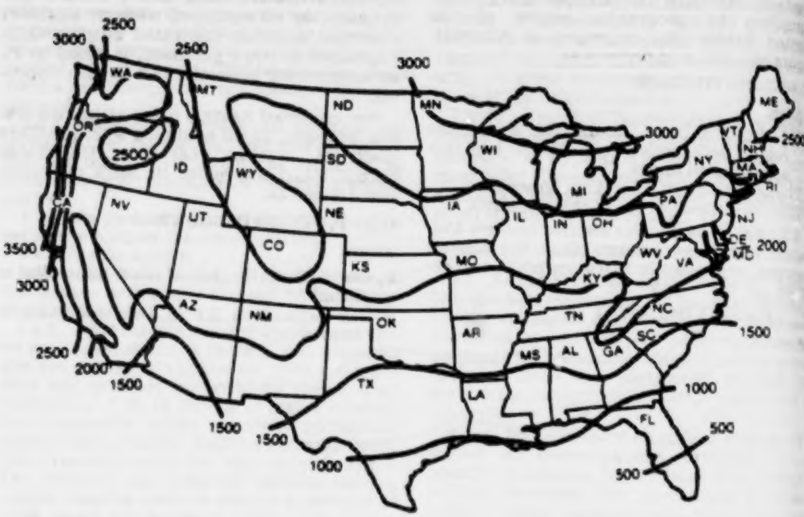
FIGURE I

Heating Load Hours (HLH) for the United States and Territories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2000
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1000
LA
FL
1500
1500
500
1000
500

This map is reasonably accurate for most parts of the United States but is necessarily highly generalized and consequently not too accurate in mountainous regions, particularly in the Rockies

Alaska	— 3500 HLH
Hawaii and Territories	— O HLH

(Energy Policy and Conservation Act, Pub. L. 94-163, as amended by Pub. L. 94-385; Federal Energy Administration Act of 1974, Pub. L. 93-275, as amended by Pub. L. 94-385; Department of Energy Organization Act, Pub. L. 95-91; E.O. 11790, 39 FR 23185)

[43 FR 20132, May 10, 1978. Redesignated and amended at 44 FR 37938, June 29, 1979; 49 FR 12157, Mar. 28, 1984]

APPENDIX H TO SUBPART B OF PART 430—UNIFORM TEST METHOD FOR MEASURING THE ENERGY CONSUMPTION OF TELEVISION SETS

1. DEFINITIONS

1.1 "IRE-unit flat field" means a specific video electrical signal which results in a particular level of brightness of the television screen as established by the Institute of Radio Engineers.

1.2 "Filament keep-warm" means a feature that provides a voltage to keep vacuum tube and/or picture tube filaments warm for the purpose of allowing almost instantaneous response to the power control swtich.

1.3 "Operating time" (L_o) means the hours per year during which the television set is operating with power control turned on.

1.4 "Remote control" means an optional feature which allows the user to control the television set from more than one location by a hand held device.

1.5 "Standby power consumption" (P_s) means the minimum amount of energy consumed with the power control switch turned off.

1.6 "Standby time" (L_s) means the hours per year during which the television set is connected to a power outlet with the power control switch turned off.

1.7 "Vacation switch or master on-off switch" means an optional energy saving feature incorporated into the design of a television set that permits the user to disconnect the filament keep-warm circuit(s).

1.8 "Remote control defeat switch" means a switch which permits the user to disconnect all standby power to a television set.

2. TESTING CONDITIONS AND MEASUREMENTS

2.1 *Test equipment and test signals.* The following equipment and test signals shall be used for testing of television sets.

2.1.1 Regulated power source capable of supplying 120 volts (±1.2 volts) alternating current.

2.1.2 Signal generator capable of producing radio frequency (RF) television test signals, at a convenient very high frequency (VHF) channel, modulated with, National Television System Committee composite video as follows:

2.1.2.1 Standard White Pattern, RF signal modulated to 87 percent with a 100 IRE-unit flat field.

2.1.2.2 Standard Black Pattern, all adjustments as for 2.1.2.1 except modulated with a zero IRE-unit flat field.

2.1.2.3 The test signals in 2.1.2.1 and 2.1.2.2, supplied by a source whose impedance equals the design antenna impedance of the television set under test, shall be adjusted to a level of 70 decibels (dB) ±3dB, referred to a zero dB level of one femtowatt (1×10^{-15} watt) available power. (For a 300 ohm source, 70 dB referred to one femtowatt corresponds to an open-circuit voltage of 3.5 millivolts. For the calculation of "available power" use American National Standard C.16.13-1961, Method of Testing Monochrome Television Broadcast Receivers.)

2.1.3 Wattmeter capable of measuring the average power consumption of the television set under test. The wattmeter shall be accurate to within 1 percent of the full scale value. All measurements shall be made on the upper half of the scale of the wattmeter.

2.2 *Initial set-up of television set.*

2.2.1 Remove all batteries from television sets designed for both battery and alternating current operation. Deactivate all present or automatic controls affecting brightness which are customer options. Adjust all non-customer controls according to the manufacturer's service procedure.

2.2.2 Apply power to the television set under test from the power source specified in 2.1.1 through the wattmeter specified in 2.1.3. Adjust the volume control to the lowest possible setting.

2.2.3 Connect the output of the signal generator as specified in 2.1.2 to the VHF antenna terminals of the television set. Tune the television set to the channel of the RF signal.

2.3 *Measurement of operating power consumption (P_o)*

2.3.1 Turn on the television set and allow at least five minutes warm-up time. With the synchronization controls adjusted for a stable test pattern, apply the standard white pattern specified in 2.1.2.1 to the television set. Adjust any customer controls other than the volume or synchronization controls for maximum power consumption as indicated by the wattmeter specified in 2.1.3. Illuminate any room illuminance sensor which has not been deactivated, to produce maximum power consumption. Record the white pattern consumption (P_w) as indicated by the wattmeter in watts.

2.3.2 Change the signal source to the standard black pattern specified in 2.1.2.2. Adjust any customer controls, other than the volume or synchronization controls, for the minimum power consumption as indicated by the wattmeter. Cover any room illuminance sensor which has not been deactivated. Record the black pattern power consumption (P_b) as indicated by the wattmeter in watts.

2.3.3 Compute the operating power consumption (p_o) as follows:

$$P_o=(P_w+P_b/2)$$

where

P_o=operating power consumption in watts

P_w=as determined from 2.3.1

P_b=as determined from 2.3.2

2.2 *Measurements of standby power consumption (P_s)*

2.4.1 For television sets without either a vacation switch or a remote control defeat switch, turn the power switch off and after two minutes measure the standby power consumption (P).

2.4.2 For a television set equipped with a remote control defeat switch, a vacation switch or both, turn the power switch, any vacation switch, and any remote er consumptions, (P_{max}).The standby power is then calculated from the equation:

$$P_s=[(P_{max}-P_{min})/2]+P_{min}$$

where

P_s=standby power consumption in watts

P_{max}=power consumption, in watts, measured with the television set power switch off and the vacation switch and remote control defeat switch in the highest energy consuming position.

P_{min}=power consumption, in watts, measured with the television set power switch off and the vacation switch and remote control defeat switch in the lowest energy consuming position.

3.0 *Average Annual Energy Consumption*

$$E=(P_oL_o/1{,}000)+(P_sL_s/1{,}000)=2.2P_o+6.56P_s$$

where

E=total average energy consumed by the television set (kilowatt-hour per year)
P_o=operating power consumption as computed in 2.3.3
t_o=operating time, 2,200 h/yr
P_s=standby power consumption computed in 2.4
t_s=standby time, 6,560 h/yr

[42 FR 46154, Sept. 14, 1977. Redesignated and amended at 44 FR 37938, June 29, 1979]

Appendix I to Subpart B of Part 430—Uniform Test Method for Measuring the Energy Consumption of Conventional Ranges, Conventional Cooking Tops, Conventional Ovens, Microwave Ovens and Microwave/Conventional Ranges

1. DEFINITIONS

1.1 "Built-in" means the product is supported by surrounding cabinetry, walls, or other similar structures.

1.2 "Drop-in" means the product is supported by horizontal surface cabinetry.

1.3 "Forced convection" means a mode of conventional oven operation in which a fan is used to circulate the heated air within the oven compartment during cooking.

1.4 "Freestanding" means the product is not supported by surrounding cabinetry, walls, or other similar structures.

1.5 "Normal nonoperating temperature" means the temperature of all areas of an of an appliance to be tested that is within 5 degrees of the temperature that the identical areas of the same basic model of the appliance would attain if it remained in the test room for 24 hours while not operating with all oven doors closed and with any gas pilot lights on and adjusted in accordance with manufacturer's instructions.

1.6 "Primary energy consumption" means either the electrical energy consumption of a conventional electric oven or the gas energy consumption of a conventional gas oven.

1.7 "Secondary energy consumption" means any electrical energy consumption, other than clock energy consumption, of a conventional gas oven.

1.8 "Standard cubic foot of gas" means that quantity of gas that occupies 1 cubic foot when saturated with water vapor at a temperature of 60° F and a pressure of 30 inches of mercury (density of mercury equals 13.595 grams per cubic centimeter).

1.9 "Thermocouple" means a device consisting of two dissimilar metals which are joined together and, with their associated wires, are used to measure temperature by means of electromotive force.

2. TEST CONDITIONS

2.1 *Installation.* A free standing applicance shall be installed with the back directly against, or as near as possible to, a vertical wall which extends at least 1 foot above and on either side of the appliance. There shall be no side walls. A drop-in, built-in or wall-mounted applicance shall be installed in an enclosure in accordance with the manufacturer's instructions. These appliances are to be completely assembled with all handles, knobs, guards and the like mounted in place. Any electric resistance heaters, gas burners, baking racks, and baffles shall be in place in accordance with the manufacturer's instructions; however, broiler pans are to be removed from the oven's baking compartment.

Disconnect any electrical clock which uses energy continuously. Do not disconnect or modify the circuit to any other electrical devices or features, except as indicated in 2.1.3.

2.1.1 *Conventional electric ranges, ovens and cooking tops and microwave/conventional electric ranges.* These products shall be connected to an electrical supply circuit with voltage as specified in 2.2.1 with a watt-hour meter installed in the circuit. The watt-hour meter shall be as described in 2.9.1.1.

2.1.2 *Conventional gas ranges, ovens, and cooking tops and gas microwave/conventional gas ranges.* These products shall be connected to a gas supply line with a gas meter installed between the supply line and the appliance being tested, according to manufacturer's specifications. The gas meter shall be as described in 2.9.2. Conventional gas ranges, ovens and cooking tops and microwave/conventional gas ranges with electrical ignition devices or other electrical components shall be connected to an electrical supply circuit of nameplate voltage with a watt-hour meter installed in the circuit. The watt-hour meter shall be as described in 2.9.1.1.

2.1.3 *Microwave ovens.* Install the microwave oven in accordance with the manufacturer's instructions and connect to an electrical supply circuit with voltage as specified in section 2.2.1. Disconnect all electrical devices or features, including clocks, which draw power when the microwave oven is turned off and which are not required for the operation of the oven. A watt-hour meter shall be installed in the circuit and shall be as described in 2.9.1.1.

2.2 *Energy supply.*

2.2.1 *Electrical supply.* Maintain the electrical supply to the conventional range, conventional cooking top, conventional oven, and microwave/conventional range being tested at 240/120 volts except that basic models rated only at 208/120 volts shall be tested at that rating. Maintain the electrical supply to a microwave oven at 120 volts and at 60 hertz. In every case, maintain the voltage within 2 percent of the voltage at which the appliance is tested.

2.2.2 *Gas supply.*

2.2.2.1 *Gas burner adjustments.* Conventional gas ranges, ovens, and cooking tops and microwave/conventional gas ranges shall be tested with all of the gas burners adjusted in accordance with the installation or operation instructions provided by the manufacturer. In every case, the burner must be adjusted with sufficient air flow to prevent a yellow flame or a flame with yellow tips.

2.2.2.2 *Natural gas.* For testing convertible cooking appliances or appliances which are designed to operate using only natural gas, maintain the natural gas pressure immediately ahead of all controls of the unit under test at 7 to 10 inches of water column. The regulator outlet pressure shall be approximately that recommended by the manufacturer. The natural gas supplied should have a heating value of approximately 1,025 Btu's per standard cubic foot. The actual gross heating value, H_n, in Btu's per standard cubic foot, for the natural gas to be used in the test shall be obtained either from measurements made by the manufacturer conducting the test using a standard continuous flow calorimeter as described in 2.9.4 or by the use of bottled natural gas whose gross heating value is certified to be at least as accurate a value as could be obtained from measurements taken with a standard continuous flow calorimeter as described in 2.9.4.

2.2.2.3 *Propane.* For testing convertible cooking appliances with propane or for testing appliances which are designed to operate using only LP-gas, maintain the propane pressure immediately ahead of all controls of the unit under test at 11 to 13 inches of water column. The regulator outlet pressure shall be approximately that recommended by the manufacturer. The propane supplied should have a heating value of approximately 2,500 Btu's per standard cubic foot. The actual gross heating value, H_p, in Btu's per standard cubic foot, for the propane to be used in the test shall be obtained either from measurements made by the manufacturer conducting the test using a standard continuous flow calorimeter as described in 2.9.4 or by the use of bottled propane whose gross heating value is certified to be at least as accurate a value as could be obtained from measurements taken with a standard continuous flow calorimeter as described in 2.9.4.

2.2.2.4 *Test gas.* A basic model of a convertible cooking appliance shall be tested with natural gas, but may also be tested with propane. Any basic model of a conventional range, conventional cooking top, or conventional oven which is designed to operate using only natural gas as the energy source must be tested with natural gas. Any basic model of a conventional range, conventional cooking top, or conventional oven which is designed to operate using only LP gas as the gas energy source must be tested with propane gas.

2.3 *Air circulation.* Maintain air circulation in the room sufficient to secure reasonably uniform temperature distribution, but do not cause a direct draft on the unit under test.

2.4 *Setting the conventional oven thermostat.*

2.4.1 *Conventional electric oven.* Install a thermocouple approximately in the center of the usable baking space. Provide a temperature indicator system for measuring the oven's temperature with an accuracy as indicated in 2.9.3.2. If the oven thermostat does not cycle on and off, adjust or determine the conventional electric oven thermostat setting to provide an average internal temperature which is 325°±5° F higher than the room ambient air temperature. If the oven thermostat operates by cycling on and off, adjust or determine the conventional electric oven thermostat setting to provide an average internal temperature which is 325°±5° F higher than the room ambient air temperature. This shall be done by measuring the maximum and minimum temperatures in any three consecutive cut-off/cut-on actions of the electric resistance heaters, excluding the initial cut-off/cut-on action, by the thermostat after the temperature rise of 325°±5° F has been attained by the conventional electric oven. Remove the thermocouple after the thermostat has been set.

2.4.2 *Conventional gas oven.* Install five parallel-connected weighted thermocouples, one located at the center of the conventional gas oven's usable baking space and the other four equally spaced between the center and the corners of the conventional gas oven on the diagonals of a horizontal plane through the center of the conventional gas oven. Each weighted thermocouple shall be constructed of a copper disc that is 1-inch in diameter and ⅛-inch thick. The two thermocouple wires shall be located in two holes in the disc spaced ½-inch apart, with each hole being located ¼-inch from the center of the disc. Both thermocouple wires shall be silver-soldered to the copper disc. Provide a temperature indicator system for measuring the oven's temperature with an accuracy as indicated in 2.9.3.2. If the oven thermostat does not cycle on or off, adjust or determine the conventional gas oven thermostat setting to provide an average internal temperature which is 325°±5° F higher than the room ambient air temperature. If the oven thermostat operates by cycling on and off, adjust or determine the conventional electric oven thermostat setting to provide an average internal temperature which is 325°±5° F higher than the room ambient air temperature. This shall be done by measuring the maximum and minimum temperatures in any three consecutive cut-off/cut-on actions of the gas burners, excluding the initial cut-off/cut-on action, by the thermostat after the temperature rise of 325°±5° F has been attained by the conventional gas oven. Remove the thermocouples after the thermostat has been set.

2.5 *Ambient room air temperature.* During the test, maintain an ambient room air temperature, T_R, of 77°±9° F as measured at least 5 feet and not more than 8 feet from the nearest surface of the unit under test and approximately 3 feet above the floor. The temperature shall be measured with a thermometer or temperature indicating system with an accuracy as indicated in 2.9.3.1.

2.6 *Normal nonoperating temperature.* All areas of the appliance to be tested shall attain the normal nonoperating temperature, as defined in 1.5, before any testing begins. The equipment for measuring the applicable normal nonoperating temperature shall be as described in 2.9.3.1, 2.9.3.2, 2.9.3.4, and 2.9.3.5, as applicable.

2.7 *Test blocks for conventional oven and cooking top.* The test blocks shall be made of aluminum alloy No. 6061, with a specific heat of 0.23 Btu's/lb-°F and with any temper that will give a coefficient of thermal conductivity of 0.37 to 0.41 cal/cm-°C-sec. Each block shall have a hole at its top. The hole shall be 0.08 inch in diameter and 0.80 inch deep. The manufacturer conducting the test may provide other means which will ensure that the thermocouple junction is installed at this same position and depth.

The bottom of each block shall be flat to within 0.002 inch TIR (total indicator reading). Determine the actual weight of each test block with a scale with an accuracy as indicated in 2.9.5.

2.7.1 *Conventional oven test block.* The test block for the conventional oven, W_1, shall be 6.25±0.05 inch in diameter, approximately 2.8 inches high and shall weigh 8.5±0.1 lbs. The block shall be finished with an anodic black coating which has a minimum thickness of 0.001 inch or with a finish having the equivalent absorptivity.

2.7.2 *Small test block for conventional cooking top.* The small test block, W_2, shall be 6.25±0.05 inches in diameter, approximately 2.8 inches high and shall weigh 8.5±0.1 lbs.

2.7.3 *Large test block for conventional cooking top.* The large test block for the conventional cooking top, W_3, shall be 9±0.05 inches in diameter, approximately 3.0 inches high and shall weigh 19±0.1 lbs.

2.7.4 *Thermocouple installation.* Install the thermocouple such that the thermocouple junction (where the thermocouple contacts the test block) is at the bottom of the hole provided in the test block and that the thermocouple junction makes good thermal contact with the aluminum block. If the test blocks are to be water cooled between tests the thermocouple hole should be sealed, or other steps taken, to insure that the thermocouple hole is completely dry at the start of the next test. Provide a temperature indicator system for measuring the test block temperature with an accuracy as indicated in 2.9.3.3.

2.7.5 *Initial test block temperature.* Maintain the initial temperature of the test blocks, T_I, within ±4° F of the ambient room air temperature as specified in 2.5. If the test block has been cooled (or heated) to bring it to room temperature, allow the block to stabilize for at least 2 minutes after removal from the cooling (or heating) source, before measuring its initial temperature.

2.8 *Test beakers.*

2.8.1 *Test beaker description.* The five test beakers shall be made of a thin walled borosilicate glass. Two of the test beakers shall have an inside diameter of approximately 85 millimeters (mm). Three of the test beakers shall have an inside diameter of approximately 110 mm.

2.8.2 *Test beaker load.* Fill one of the 85 mm diameter test beakers with 275 milliliters (ml)±2.75 ml of distilled water containing 1 percent sodium chloride (NaCl) by weight. Fill one of the 85 mm diameter test beakers with 500 ml±5.0 ml of distilled water containing 1 percent NaCl by weight. Fill each of the 110 mm diameter test beakers with 1,000 ml±10.0 ml of distilled water containing 1 percent NaCl by weight.

2.8.2.1 *Test beaker water load temperature.* Maintain the initial temperature of the test beaker water load within the range of 68° F to 77° F. The temperature shall be measured with a thermometer or other equipment with an accuracy as indicated in 2.9.3.4.

2.9 *Instrumentation.* Perform all test measurements using the following instruments, as appropriate:

2.9.1 *Electrical Measurements.*

2.9.1.1 *Watt-hour meter.* The watt-hour meter for measuring the electrical energy consumption of conventional ovens and cooking tops shall have a resolution of at least 1 watt-hour and a maximum error no greater than 1.5 percent of the measured value for any demand greater than 100 watts. The watt-hour meter for measuring the energy consumption of microwave ovens shall have a resolution of at least 0.1 watt-hour and a maximum error no greater than 1.5 percent of the measured value.

2.9.1.2 *Wattmeter.* The wattmeter shall have a resolution of at least 0.2 watt and a maximum error no greater than 5 percent of the measured value over the range of 0 to 10 watts.

2.9.2 *Gas Measurements.*

2.9.2.1 *Positive displacement meters.* The gas meter to be used for measuring the gas consumed by the gas burners of the oven or cooking top shall have a resolution of at least 0.01 cubic foot and a maximum error no greater than 1 percent of the measured value for any demand greater than 2.2 cubic feet per hour. If a positive displacement gas meter is used for measuring the gas consumed by the pilot lights, it shall have a resolution of at least 0.01 cubic foot and have a maximum error no greater than 2 percent of the measured value.

2.9.2.2 *Flow meter.* If a gas flow meter is used for measuring the gas consumed by the pilot lights, it shall be calibrated to have a maximum error no greater than 1.5 percent of the measured value and a resolution of at least 1 percent of the measured value.

2.9.3 *Temperature measurement equipment.*

2.9.3.1 *Room temperature indicating system.* The room temperature indicating system shall have an error no greater than ±1° F over the range 65° to 90° F.

2.9.3.2 *Temperature indicator system for measuring conventional oven temperature.* The equipment for measuring the conventional oven temperature shall have an error no greater than ±4° F over the range of 65° to 500° F.

2.9.3.3 *Temperature indicator system for measuring test block temperature.* The system shall have an error no greater than 2° F when measuring specific temperatures over the range of 65° to 330° F. It shall also have an error no greater than 2° F when measuring any temperature difference up to 240° F within the above range.

2.9.3.4 *Microwave oven and test load temperatures.* The thermometer or other equipment used to measure the microwave oven temperature and its test load temperature shall have an error no greater than 1° F over the range of 65° to 140° F.

2.9.3.5 *Temperature indicator system for measuring surface temperatures.* The temperatures of an external surface of an appliance shall be measured by means of a thermocouple in firm contact with the surface. The temperature indicating system shall have an error no greater than ±1° F over the range 65° to 90° F.

2.9.4 *Standard continuous flow calorimeter.* The calorimeter shall have an operating range of 750 to 3,500 Btu's per cubic foot. The maximum error of the basic calorimeter shall be no greater than 0.2 percent of the gross heating value of the gas used in the test. The indicator readout shall have a maximum error no greater than 0.5 percent of the measured value within the above operating range and a resolution of 0.2 percent or less of the full scale reading of the indicator instrument.

2.9.5 *Scale.* The scale used for weighing the test blocks shall have a maximum error no greater than one ounce.

3. TEST METHODS AND MEASUREMENTS

3.1 *Test methods.*

3.1.1 *Conventional oven.* Perform a test by establishing the testing conditions set forth in 2 of this appendix, and adjust any pilot lights of a conventional gas oven in accordance with the manufacturer's instructions and turn off the gas flow to the conventional cooking top, if so equipped.

Before beginning the test, the conventional oven shall be at its normal nonoperating temperature as defined in 1.5 and described in 2.6. Set the conventional oven test block W_1 approximately in the center of the usable baking space. If there is a selector switch for selecting the mode of operation of the oven, set for normal baking. If an oven permits baking by either forced convention using a fan, or without forced convection, the oven is to be tested in each of those two modes. If the oven thermostat does not cycle on and off, adjust or determine the conventional electric oven thermostat setting to provide an average internal temperature which is 325° ±5° F higher than the room ambient air temperature. If the oven thermostat operates by cycling on and off, adjust or determine the conventional electric oven thermostat setting to provide an average internal temperature which is 325° ±5° of higher than the room ambient air temperature. If the oven thermostat operates by cycling on and off, the oven shall remain on for at least one complete thermostat "cut-off/cut-on" of the electrical resistance heaters or gas burners after the test block temperature has increased 234° F above its initial temperature.

3.1.1.1 *Self-cleaning operation of a conventional oven.* Perform a test by establishing the test conditions set forth in 2 of this appendix. Adjust any pilot lights of a conventional gas oven in accordance with the manufacturer's instructions and turn off the gas flow to the conventional cooking top. The temperature of the conventional oven shall be its normal nonoperating temperature as defined in 1.5 and described in 2.6. Then set the conventional oven's self-cleaning process in accordance with the manufacturer's instructions. If the self-cleaning process is adjustable, use the average time recommended by the manufacturer for a moderately soiled oven.

3.1.1.2 *Continuously burning pilot lights of a conventional gas oven.* Perform a test by establishing the test conditions set forth in 2 of this appendix. Adjust any pilot lights of a conventional gas oven in accordance with the manufacturer's instructions and turn off the gas flow to the conventional cooking top. If a positive displacement gas meter is used the test duration shall be sufficient to measure a gas consumption which is at least 200 times the resolution of the gas meter.

3.1.2 *Conventional cooking top.* Perform a test by establishing the test conditions set forth in 2 of this Appendix. Adjust any pilot lights of a conventional gas cooking top in accordance with the manufacturer's instructions and turn off the gas flow to the conventional oven(s), if so equipped. The temperature of the conventional cooking top shall be its normal nonoperating temperature as defined in 1.5 and described in 2.6. Set the test block in the center of the surface unit under test. The small test block, W_s, shall be used on electric surface units of 7 inches or less in diameter. The large test block, W_L, shall be used on electric surface units over 7 inches in diameter and on all gas surface units. Turn on the surface unit under test and set its energy input rate to the maximum setting (100 percent). When the test block reaches 144°F above its initial test block temperature, immediately reduce the energy input rate to 25±5 percent of the maximum energy input rate. After 15±0.1 minutes at the reduced energy setting, turn off the surface unit under test.

3.1.2.1 *Continuously burning pilot lights of a conventional gas cooking top.* Perform a test by establishing the test conditions set forth in 2 of this Appendix. Adjust any pilot lights of a conventional gas cooking top in accordance with the manufacturer's instructions and turn off the gas flow to the conventional oven(s). If a positive displacement gas meter is used the test duration shall be sufficient to measure a gas consumption which is at least 200 times the resolution of the gas meter.

3.1.3 *Microwave oven.* Perform the tests by establishing the testing conditions set forth in 2 of this Appendix. Four tests are to be conducted with the water test loads in the following sequence: 2,000 ml, 1,000 ml, 500 ml and 275 ml. For each test, place the appropriate test beaker(s) containing the water load specified in 2.8.2 in approximately the center of the load carrying surface of the oven, and operate the microwave oven at its maximum microwave power setting until the temperature of the water load has been raised 45±9° F. Allow one minute for changing the test load beakers between each of the tests.

For the 2,000 ml test, set the two test beakers, each containing 1,000 ml of the specified water load, side by side, in the approximate center of the oven.

3.2 *Test measurements.*

3.2.1 *Conventional oven test energy consumption.* If the oven thermostat is a type which controls the oven temperature without cycling on and off, measure the energy consumed, E_O, when the temperature of the block reaches T_O (T_O is 234° F above the initial block temperature, T_I). If the oven thermostat operates by cycling on and off, make the following series of measurements: Measure the block temperature, T_A, and the energy consumed, E_A, at the end of the last "ON" period of the conventional oven before the block reaches T_O. Measure the block temperature, T_B, and the energy consumed, E_B, at the beginning of the next "ON" period. Measure the block temperature, T_C, and the energy consumed, E_C, at the end of that "ON" period. Measure the block temperature, T_D, and the energy consumed, E_D, at the beginning of the following "ON" period. Energy measurements for E_A, E_B, E_C and E_D should be expressed in watt-hours for conventional electric ovens or standard cubic feet of gas for conventional gas ovens. For a gas oven measure in watt-hours any electrical energy, E_{IO}, consumed by an ignition device or other electrical components required for the operation of a conventional gas oven while heating the test block to T_O.

3.2.1.1 *Energy consumption of self-cleaning operation.* Measure the self-cleaning conventional electric or gas oven energy consumption, E_s, specified as the number of watt-hours of electrical energy or standard cubic feet of gas, respectively, consumed during the self-cleaning test set forth in 3.1.1.1. For a gas oven also measure in watt-hours any electrical energy, E_{IS}, consumed by an ignition device or other electrical components required during the self-cleaning test.

3.2.1.2 *Gas consumption of continuously burning pilot lights.* Measure the gas consumption of the pilot lights, P_s, in standard cubic feet of gas and the test duration, L, in hours for the test set forth in 3.1.1.2. If a gas flow meter is used, measure the flow rate, P_s, in standard cubic feet per hour.

3.2.1.3 *Clock power.* If the conventional oven, conventional range, or microwave/conventional range includes an electric clock which is on continuously, and the power rating in watts of this feature is not know, measure the clock power, P_{CL}, in watts.

3.2.2 *Conventional surface unit test energy consumption.* For the surface unit under test, measure the energy consumption, E_{CT}, in standard cubic feet of gas or watt-hours of electricity, respectively, and the test block temperature, T_{CT}, at the end of the 15 minute (reduced input setting) test interval for the test specified in 3.1.2 and the total time, T_T, in hours, that the unit is under test. Measure any electrical energy, E_{IC}, consumed by an ignition device of a gas heating element in watt-hours.

3.2.2.1 *Gas consumption of continuously burning pilot lights.* If the conventional gas cooking top under test has one or more continuously burning pilot lights, measure the gas consumed during the test by the pilot lights, P_c, in standard cubic feet of gas, and the test duration, L_c, in hours as specified in 3.1.2.1. If a gas flow meter is used, measure the flow rate, P, in standard cubic feet per hour.

3.2.3 *Microwave oven test energy consumption.* Measure the initial, T_I, and final, T_F, temperatures, in degrees Fahrenheit (°F), of the water test load for the 2,000 ml, 1,000 ml, 500 ml and 275 ml tests. The final temperature, T_F, shall be measured after the test load has been stirred to insure uniform temperature distribution. Measure the elapsed time, t, in seconds, until the temperature rise of the water load is $45 \pm 9°$ F.

Measure for each test specified in 3.1.3 the electical input energy, E_M, in watt-hours consumed by the microwave oven during the elapsed time, t.

3.3 *Recorded values.*

3.3.1 Record the test room temperature, T_R, at the start and end of each test.

3.3.2 Record measured test block weights W_1, W_2, and W_3 in pounds.

3.3.3 Record the initial temperature, T_I, of the test block under test.

3.3.4 For a conventional oven with a thermostat which operates by cycling on and off, record the conventional oven test measurements T_A, E_A, T_B, E_B, T_C, E_C, T_D, and E_D. If the thermostat controls the oven temperature without cycling on and off, record E_O. For a gas oven which also uses electrical energy for the ignition or operation of the oven, also record E_{IO}.

3.3.5 Record the measured energy consumption, E_S, and for a gas oven, any electrical energy, E_{IS}, for the test of the self-cleaning operation of a conventional oven.

3.3.6 Record the gas flow rate, P_s; or the gas consumption, P_o, and the elapsed time, L_o, that any continuously burning pilot lights of a conventional oven are under test.

3.3.7 Record the clock power measurement or rating, P_{CL}, in watts.

3.3.8 For the surface unit under test, record the energy consumption, E_{CT}, the final test block temperature, T_{CT}, the total test time, T_T. For a gas cooking top which uses electrical energy for ignition of the burners, also record E_{IC}.

3.3.9 Record the gas flow rate, P; or the gas consumption, P_c, and the elapsed time, L_c, that any continuously burning pilot lights of a conventional cooking top are under test.

3.3.10 Record the heating value, H_n, as determined in 2.2.2.2 for the natural gas supply.

3.3.11 Record the heating value, H_p, as determined in 2.2.2.3 for the propane supply.

3.3.12 Record the electrical input energy, E_M, the elapsed time, t, and initial, T_I, and final, T_F, temperature of the water load for each microwave oven test.

4. CALCULATION OF DERIVED RESULTS FROM TEST MEASUREMENTS

4.1 *Conventional oven.*

4.1.1 *Test energy consumption.* For a conventional oven with a thermostat which operates by cycling on and off calculate the test energy consumption, E_O, corresponding to T_O with the aid of the figure in 5 of this Appendix, expressed in watt-hours for electric ovens and in Btu's for gas ovens, and defined as:

$$E_O = E_{AB} + \left[\left(\frac{T_O - T_{AB}}{T_{CD} - T_{AB}}\right) \times (E_{CD} - E_{AB})\right] \quad \text{for electric ovens,}$$

$$\text{and, } E_O = (E_{AB} \times H) + \left[\left(\frac{T_O - T_{AB}}{T_{CD} - T_{AB}}\right) \times \left(E_{CD} - E_{AB}\right) \times H\right] \quad \text{for gas ovens}$$

where:

H=either H_n or H_p, the heating value of the gas used in the test as specified in 2.2.2.2 and 2.2.2.3, expressed in Btu's per standard cubic foot.

$$T_O = 234°F \text{ plus the initial test block temperature}$$

$$T_{AB} = \frac{T_A + T_B}{2}$$

$$T_{CD} = \frac{T_C + T_D}{2}$$

$$E_{AB} = \frac{E_A + E_B}{2}$$

$$E_{CD} = \frac{E_C + E_D}{2}, \text{ where}$$

where:

T_A=block temperature at the end of the last "ON" period of the conventional oven before the test block reaches T_O.

E_A=volume of gas consumed in standard cubic feet at the end of the last "ON" period before the test block reaches T_O.

T_B=block temperature at the beginning of the "ON" period following the measurement of T_A.

E_B=volume of gas consumed in standard cubic feet of gas at the beginning of the "ON" period following the measurement T_A.

T_C=block temperature at the end of the "ON" period which starts with T_B.

E_C=volume of gas consumed in standard cubic feet of gas at the end of the "ON" period which starts with T_B.

T_D=block temperature at the beginning of the "ON" period which follows the measurement of T_C.

E_D=volume of gas consumed in standard cubic feet of gas at the beginning of the "ON" period which follows the measurement of T_C.

4.1.1.1 *Average test energy consumption.* If the conventional oven can be operated with or without forced convection, determine the average test energy consumption, E_O and E_{IO}, using the following equations:

$$E_O = \frac{(E_O)_1 + (E_O)_2}{2}$$

$$E_{IO} = \frac{(E_{IO})_1 + (E_{IO})_2}{2},$$

where:

$(E_O)_1$, $(E_O)_2$=Test energy consumption in each baking mode as measured in 3.2.1 or as calculated in 4.1.1.

$(E_{IO})_1$, $(E_{IO})_2$=electrical energy consumption of a gas oven in each baking mode as measured in 3.2.1.

4.1.2 *Conventional oven annual energy consumption.*

4.1.2.1. *Annual cooking energy consumption.*

4.1.2.1.1. *Annual primary energy consumption.* Calculate the annual primary energy consumption for cooking, E_{CO}, expressed in kilowatt-hours for electric ovens and in Btu's for gas ovens, and defined as:

$$E_{CO} = \frac{E_O \times H_E \times O_O}{W_1 \times C_p \times T} \quad \text{for electric ovens,}$$

where:

E_O=test energy consumption as calculated in 4.1.1 of 4.1.1.1.

H_E=3.412 Btu's/Wh, conversion factor of watt-hours to Btu's.

O_O=47.09 kWh's, annual useful cooking energy output of conventional electric oven.

W_1=measured weight of test block in pounds.

C_p=0.23 Btu/lb-°F, specific heat of test block.

or,

T=234°F, temperature rise of test block.

$$\text{or,} \quad E_{CO} = \frac{E_O \times O_O}{W_1 \times C_p \times T} \quad \text{for gas ovens,}$$

where:

E_O=test energy consumption as measured in 3.2.1. or as calculated in 4.1.1 or 4.1.1.1.

O_O=160,700 Btu's, annual useful cooking energy output of conventional gas oven.

W_1C_p and T are the same as defined above.

4.1.2.1.2 *Annual secondary energy consumption for cooking of gas ovens.* Calculate the annual secondary energy consumption for cooking, E_{SO}, expressed in kilowatt-hours and defined as:

$$E_{SO} = \frac{E_{IO} \times H_E \times O_O}{W_1 \times C_p \times T},$$

where:

E_{IO}=electrical test energy consumption according to 3.2.1 or as calculated in 4.1.1.1.

O_O=47.09 kWh's, annual useful cooking energy output.

H_E, W_1, C_p, and T are as defined in 4.1.2.1.1.

4.1.2.2 *Annual energy consumption of any continuously burning pilot lights.* Calculate the annual energy consumption of any continuously burning pilot lights, E_{PO}, expressed in Btu's and defined as:

$$E_{PO} = P_B \times H \times (A-B),$$

where:

$$P_R = \frac{P_O}{L_O}$$

=pilot flow rate in standard cubic feet per hour where P_0 and L_0 are defined below.

P_0=Standard cubic feet of gas consumed by any continuously burning pilot lights as determined in 3.2.1.2.

$H=H_n$ or H_p,the heating value of the gas used in the test as specified in 2.2.2.2 and 2.2.2.3 in Btu's per standard cubic foot.

L_0=elapsed test time in hours for any continuously burning pilot lights tested.

A=8,760, number of hours in a year.

B=300, number of hours any continuously burning pilot lights contribute to the heating of an oven for cooking food.

4.1.2.3 *Annual conventional oven self-cleaning energy.*

4.1.2.3.1 *Annual primary energy consumption.* Calculate the annual primary energy consumption for conventional oven self-cleaning operations, E_{SC}, expressed in kilowatt-hours for electric ovens and in Btu's for gas ovens, and defined as:

$E_{SC}=E_s \times S_e \times C$, for electric ovens,

where:

E_s=energy consumption in watt-hours as measured in 3.2.1.1.

S_e=11, average number of times a self-cleaning operation of a conventional electric oven is used per year.

C=.001 kW/W conversion factor of watts to kilowatts.

or

$E_{SC}=E_g \times H \times S_g$, for gas ovens,

where:

E_g=gas consumption in standard cubic feet per oven tested according to 3.2.1.1.

$H=H_n$ or H_p, the heating value of the gas used in the test as specified in 2.2.2.2 and 2.2.2.3 in Btu's per standard cubic foot.

S_g=7, average number of times a self-cleaning operation of a conventional gas oven is used per year.

4.1.2.3.2 *Annual secondary energy consumption for self-cleaning operation of gas ovens.* Calculate the annual secondary energy consumption for self-cleaning operations of a gas oven, E_{SS}, expressed in kilowatt-hours and defined as:

$E_{SS}=E_{ST}\times S_g\times C$,

where:

E_{ST}=electrical energy consumed during the self-cleaning operation of a conventional gas oven, as measured in 3.2.1.1.

S_g and C are the same as defined in 4.1.2.3.1.

4.1.2.4 *Annual clock energy consumption.* Calculate the annual energy consumption of any constantly operating electric clock, E_{CL}, expressed in kilowatt-hours and defined as:

$E_{CL}=P_{CL}\times H_s$,

where:

P_{CL}=power rating, in watts, of clock which is on continuously.

K_s=8.76, thousands of hours in a year.

4.1.2.5 *Total annual energy consumption of a single conventional oven.*

4.1.2.5.1 *Electric oven energy consumption.* Calculate the total annual energy consumption of a conventional electric oven, E_{AO}, expressed in kilowatt-hours and defined as:

$E_{AO}=E_{CO}+E_{SC}+E_{CL}$,

where:

E_{CO}=annual cooking energy consumption as determined in 4.1.2.1.1.

E_{SC}=annual self-cleaning energy consumption as determined in 4.1.2.3.1.

E_{CL}=annual clock energy consumption as determined in 4.1.2.4.

4.1.2.5.2 *Conventional gas oven energy consumption.* Calculate the total annual gas energy consumption of a conventional gas oven, E_{AOG}, expressed in Btu's and defined as:

$E_{AOG}=E_{CO}+E_{PO}+E_{SC}$,

where:

E_{CO}=annual primary cooking energy consumption as determined in 4.1.2.1.1.

E_{PO}=annual pilot energy consumption as determined in 4.1.2.2.

E_{SC}=annual primary self-cleaning energy consumption as determined in 4.1.2.3.1.

If the conventional gas oven uses electrical energy, calculate the total annual electrical energy consumption, E_{AOE}, expressed in kilowatt-hours, and defined as:

$E_{AOE}=E_{SO}+E_{SS}+E_{CL}$,

where:

E_{SO}=annual secondary cooking energy consumption as determined in 4.1.2.1.2.

E_{SS}=annual secondary self-cleaning energy consumption as determined in 4.1.2.3.2.

E_{CL}=annual clock energy consumption as determined in 4.1.2.4.

The total annual energy consumption of a conventional gas oven, E_{AO}, is comprised of E_{AOG}, expressed in Btu's and E_{AOE}, expressed in kilowatt-hours, as computed above.

4.1.2.6. *Total annual energy consumption of multiple conventional ovens.* If the cooking appliance includes more than one conventional oven calculate the total annual energy consumption of the conventional ovens using the following equations:

4.1.2.6.1 *Conventional electric ovens energy consumption.* Calculate the total annual energy consumption, E_{TO}, in kilowatt-hours and defined as:

$$E_{TO}=E_{ACO}+E_{ASC}+E_{CL},$$

where:

$$E_{ACO} = \frac{1}{n} \sum_{i=1}^{n} (E_{CO})_i,$$

average annual primary energy consumption for cooking, where:

n=number of conventional ovens in the basic model.

E_{CO}=annual primary energy consumption for cooking as determined in 4.1.2.1.1.

$$E_{ASC} = \frac{1}{n} \sum_{i=1}^{n} (E_{SC})_i,$$

average annual self-cleaning energy consumption, where:

n=number of self-cleaning conventional ovens in the basic model.

E_{SC}=self-cleaning energy consumption as determined according to 4.1.2.3.1.

E_{CL}=clock energy consumption as determined according to 4.1.2.4.

4.1.2.6.2 *Conventional gas ovens energy consumption.* Calculate the total annual gas energy consumption, E_{TOG}, in Btu's and define as:

$$E_{TOG}=E_{ACO}+E_{ASC}+E_{TPO},$$

where:

E_{ACO}=average annual primary energy consumption in Btu's as defined in 4.1.2.6.1.

E_{ASC}=average annual self-cleaning energy consumption in Btu's as defined in 4.1.2.6.1.

$$E_{TPO} = \sum_{i=1}^{n} (E_{PO})_i,$$

total annual energy consumption of any pilot lights, where:

E_{PO}=annual energy consumption of any continuously burning pilot lights determined according to 4.1.2.2.

n=number of pilot lights in the basic model.

If the ovens also use electrical energy calculate the total annual electrical energy consumption, E_{TOE}, in kilowatt-hours and defined as:

$$E_{TOE}=E_{ASO}+E_{ASS}+E_{CL},$$

where:

$$E_{ASO} = \frac{1}{n} \sum_{i=1}^{n} (E_{SO})_i,$$

average annual secondary energy consum tion for cooking, where:

n=number of conventional ovens in th basic model.

E_{SO}=annual secondary energy consum tion for cooking as determined i 4.1.2.1.2.

$$E_{ASS} = \frac{1}{n} \sum_{i=1}^{n} (E_{SS})_i,$$

average annual secondary self-cleanin energy consumption, where:

n=number of self-cleaning ovens in th basic model.

E_{SS}=annual secondary self-cleanin energy consumption as determined i 4.1.2.3.2.

E_{CL}=annual clock energy consumption a determined in 4.1.2.4.

The total annual energy consumption o multiple gas ovens, E_{TO}, is comprised of E expressed in Btu's, and E_{TOE} expressed in ki owatt-hours, as computed above.

4.1.3 *Conventional oven cooking efficien cy.*

4.1.3.1 *Single conventional oven.* Calc late the conventional oven cooking efficie cy, Eff_{AO}, using the following equations:

For electric ovens:

$$Eff_{AO} = \frac{W_1 \times C_p \times T}{E_O \times H_E},$$

For gas ovens:

$$Eff_{AO} = \frac{W_1 \times C_p \times T}{E_O + (E_{IO} \times H_E)},$$

where:

W_1=measured weight of test block i pounds.

C_p=0.23 Btu/lb-° F, specific heat of tes block.

T=234° F, temperature rise of test block

E_O=test energy consumption as measured in 3.2.1 or calculated in 4.1.1 or 4.1.1.1.

H_E=3.412 Btu's/Wh, conversion factor for watt-hours to Btu's.

E_{IE}=electrical test energy consumption according to 3.2.1 or as calculated in 4.1.1.1.

4.1.3.2 *Multiple conventional ovens.* If the cooking appliance includes more than one conventional oven, calculate the cooking efficiency for all of the conventional ovens in the appliance, Eff_{TO}, using the following equation:

$$Eff_{TO} = \frac{n}{\sum_{i=1}^{n} \left(\frac{1}{Eff_{AO}}\right)_i},$$

where:

n=number of conventional ovens in the cooking appliance.

Eff_{AO}=cooking efficiency of each oven determined according to 4.1.3.1.

4.1.4 *Conventional oven energy factor.*

4.1.4.1 *Single conventional oven.* Calculate the energy factor, or the ratio of useful cooking energy output to the total energy input, R_O, using the following equations:

For electric ovens,

$$R_O = \frac{O_O}{E_{AO}},$$

where:

O_O=47.09 kWh's per year, annual useful cooking energy output.

E_{AO}=total annual energy consumption as determined in 4.1.2.5.1.

For gas ovens,

$$R_O = \frac{O_O}{E_{AOG} + (E_{AOE} \times H_e)},$$

where:

O_O=160,700 Btu's per year, annual useful cooking energy output.

E_{AOG}=total annual gas energy consumption as determined in 4.1.2.5.2.

E_{AOE}=total annual electrical energy consumption as determined in 4.1.2.5.2.

H_e=3,412 Btu's/kWh, conversion factor for kilowatt-hours to Btu's.

4.1.4.2 *Multiple conventional ovens.* If the cooking appliance includes more than one conventional oven, calculate the energy factor for all of the ovens, R_{TO}, using the following equations:

For electric ovens,

$$R_{TO} = \frac{O_O}{E_{TO}},$$

where:

O_O=47.09 kWh's per year, annual useful cooking energy output.

E_{TO}=total energy consumption as determined according to 4.1.2.6.

For gas ovens.

$$R_{TO} = \frac{O_O}{E_{TOG} + (E_{TOE} \times H_e)},$$

where:

O_O=160,700 Btu's per year, annual useful cooking energy output.

E_{TOG} and E_{TOE} are determined according to 4.1.2.6.2.

H_e=3,412 Btu's/kWh, conversion factor for kilowatt-hours to Btu's.

4.2 *Conventional cooking top*

4.2.1 *Conventional cooking top cooking efficiency*

4.2.1.1 *Electric surface unit cooking efficiency.* Calculate the cooking efficiency, Eff_{SU}, of the electric surface unit under test, and defined as:

$$Eff_{SU} = W \times C_P \times \left(\frac{T_{su}}{H_E \times E_{CT}}\right),$$

where:

W=measured weight of test block, W_1 or W_2, expressed in pounds.

C_P=0.23 Btu's/lb-° F, specific heat of test block.

T_{su}=temperature rise of the test block: final test block temperature, T_{CT}, as determined in 3.2.2, minus the initial test block temperature, T_I, expressed in ° F.

H_E=3.412 Btu's/Wh, conversion factor of watt-hours to Btu's.

E_{CT}=measured energy consumption, as determined according to 3.2.2, expressed in watt-hours.

4.2.1.2 *Gas surface unit cooking efficiency.* Calculate the cooking efficiency, Eff_{SU}, of the gas surface unit under test, and defined as:

$$Eff_{SU} = \frac{W_3 \times C_P \times T_{su}}{E},$$

where:

W_s=measured weight of test block according to 3.3.2, expressed in pounds.

C_p and T_{sc} are the same as defined in 4.2.1.1.

$$E = \left[(E_{CT} - E_{CP}) \times H\right] + (E_{IC} \times H_E),$$

where:

E_{CT}=total gas consumption for the gas surface unit test as defined in 3.2.2.

E_{IC}=electrical energy consumed by an ignition device of a gas surface unit as defined in 3.2.2.

H_E=3.412 Btu's/Wh, conversion factor of watt-hours to Btu's.

H=either H_n or H_p, the heating value of the gas used in the test as specified in 2.2.2.2 and 2.2.2.3, expressed in Btu's per standard cubic foot of gas.

E_{CP}=P x T, (pilot consumption, in standard cubic feet, during unit test) where

$$P = \frac{P_c}{L_c}$$, (pilot flow in standard cubic feet per hour) where

where:

P_c=any pilot lights gas consumption defined in 3.2.2.1.

L_c=elapsed time of the cooking top pilot lights test as defined in 3.1.2.1.

T_T=the elapsed test time as defined in 3.2.2.

4.2.1.3 *Conventional cooking top cooking efficiency.* Calculate the conventional cooking top cooking efficiency, Eff_{CT}, using the following equation:

$$Eff_{CT} = \frac{1}{n} \sum_{i=1}^{n} (Eff_{SU})_i,$$

where:

n=number of surface units in the cooking top.

Eff_{SU}=the efficiency of each of the surface units, as determined according to 4.2.1.1 or 4.2.1.2.

4.2.2 *Conventional cooking top annual energy consumption.*

4.2.2.1 *Conventional electric cooking top energy consumption.* Calculate the annual energy consumption of an electric cooking top, E_{CA}, in kilowatt-hours per year and defined as:

$$E_{CA} = \frac{O_{CT}}{Eff_{CT}},$$

where:

O_{CT}=277.7 kWh per year, annual usef cooking energy output.

Eff_{CT}=conventional cooking top cooki efficiency as defined in 4.2.1.3.

4.2.2.2 *Conventional gas cooking top*

4.2.2.2.1 *Annual cooking energy con sumption.* Calculate the annual energy con sumption for cooking, E_{CC}, in Btu's per ye for a gas cooking top and defined as:

$$E_{CC} = \frac{O_{CT}}{Eff_{CT}},$$

where:

O_{CT}=947,500 Btu's, annual useful cooki energy output.

Eff_{CT}=the gas cooking top efficiency as de fined in 4.2.1.3.

4.2.2.2.2 *Annual energy consumption o any continuously burning gas pilots.* Calc late the annual energy consumption of an continuously burning gas pilot lights of th cooking top, E_{PC}, in Btu's per year and de fined as:

$$E_{PC} = P \times A \times H,$$

where:

P=pilot light flow rate as defined i 4.2.1.2, or as measured in 3.2.2.1.

A=8,760 hours, the total number of hou in a year.

H=either H_n or H_p, the heating value o the gas used in the test as specified i 2.2.2.2. and 2.2.2.3, expressed in Btu per standard cubic foot of gas.

4.2.2.2.3 *Total annual energy consump tion of a conventional gas cooking top.* Cal culate the total annual energy consumptio of a conventional gas cooking top, E_{CA}, i Btu's per year and defined as:

$$E_{CA} = E_{CC} + E_{PC},$$

where:

E_{CC}=energy consumption for cooking a determined in 4.2.2.2.1.

E_{PC}=annual energy consumption of th pilot lights as determined in 4.2.2.2.2.

4.2.3 *Conventional cooking top energ factor.* Calculate the energy factor, or rati of useful cooking energy output for cookin to the total energy input, R_{CT}, as follows:

For an electric cooking top the energ factor is the same as the cooking efficienc as determined according to 4.2.1.3.

For gas cooking tops,

$$R_{CT} = \frac{O_{CT}}{E_{CA}},$$

where:

O_{CT}=947,500 Btu's per year, annual useful cooking energy output of cooking top.

E_{CA}=total annual energy consumption of cooking top determined according to 4.2.2.2.3.

4.3 *Conventional range.*

4.3.1 *Conventional range annual energy consumption.* Calculate the conventional range annual energy consumption, E_R, in kWh's per year for electrical energy and Btu's per year for gas energy, and defined as:

$E_R=E_{AT}+E_{CA}$, where gas and electrical energy are added separately, and where

$E_{AT}=E_{AO}$ or E_{TO}, the conventional oven(s) annual energy consumption in kWh's per year and/or Btu's per year as determined in 4.1.2.5 or 4.1.2.6.

C_{CA}=the conventional cooking top annual energy consumption in kWh's per year or Btu's per year as defined in 4.2.2.

4.3.2 *Conventional range cooking efficiency.* Calculate the conventional range cooking efficiency, Eff_R, and defined as:

$$Eff_R = \frac{1}{\frac{0.145}{Eff_O} + \frac{0.855}{Eff_{CT}}},$$

where:

$Eff_O=Eff_{AO}$ or Eff_{TO}, the cooking efficiency of the oven(s) as determined according to 4.1.3.1 or 4.1.3.2.

Eff_{CT}=cooking top efficiency as determined in 4.2.1.3.

The constants 0.145 and 0.855 are fractions of the annual useful energy output represented by oven usage and cooking top usage respectively.

4.3.3 *Conventional range energy factor.* Calculate the energy factor, or the ratio of the useful cooking energy output to the total energy input on a yearly basis for the complete range, R_R, and defined as:

$$R_R = \frac{O_R}{E_R},$$

where:

O_R=1,108,000 Btu's, annual useful cooking energy output.

E_R=total annual energy consumption as determined in 4.3.1 and with all values for electrical energy converted from kilowatt-hours to Btu's by multiplying by 3,412 Btu's per kWh.

4.4 *Microwave oven.*

4.4.1 *Specific microwave oven cooking efficiency for each test load.* Calculate the specific microwave oven cooking efficiency, Eff_i, for each test load and defined as:

$$Eff_i = \frac{W \times F \times T_M}{E_M},$$

where:

W=size of the test load, in milliliters $T_M=T_F-T_I$,

where:

T_F=the final temperature expressed in °F of the test load as defined in 3.2.3.

T_I=the initial temperature expressed in °F of the test load as defined in 3.2.3.

F=.000646 Watt-hr/Ml-°F (used to convert milliliters of water times degrees Fahrenheit to watt-hours).

E_M=the energy consumption as defined in 3.2.3.

4.4.2 *Microwave oven cooking efficiency.* Calculate the microwave oven cooking efficiency, Eff_{MO}, and defined as:

$$Eff_{MO} = \frac{1}{n} \sum_{i=1}^{n} Eff_i$$

n=4, the number of test loads.

Eff_i=the specified microwave cooking efficiency of each test load as determined in 4.4.1.

4.4.3 *Microwave oven annual energy consumption.* Calculate the microwave oven annual energy consumption, E_{MO}, in kWh's per year, and defined as:

$$E_{MO} = \frac{O_M}{Eff_{MO}} + (P_{MC} \times H_K),$$

where:

O_M=34.2 kWh's per year, the microwave oven annual useful cooking energy output.

Eff_{MO}=the microwave oven cooking efficiency as defined in 4.4.2.

P_{MC}=the power rating of features (such as clocks), expressed in watts. The power rating is the power drawn from the electrical supply when the microwave oven is turned off.

H_K=8.76, the number of thousand hours in a year.

4.4.4 *Microwave oven energy factor.* Calculate the energy factor or the ratio of the useful cooking energy output to total energy input on a yearly basis, R_{MO}, and defined as:

$$R_{MO} = \frac{O_M}{E_{MO}},$$

where:

O_M=34.2 kWh, annual useful cooking energy output.

E_{MO}=annual total energy input as determined in 4.4.3.

4.5 *Microwave/conventional range.*

4.5.1 *Annual energy consumption.*

4.5.1.1 *Annual energy consumption of the conventional oven for cooking.*

4.5.1.1.1 *Annual primary energy consumption.* Calculate the annual primary energy consumption for cooking of a conventional oven in combination with a microwave oven, E_{COM}, expressed in Btu's for gas ovens and in kilowatt-hours for electric ovens, with the following equation:

$$E_{COM}=K \times E_{CO},$$

where:

K=0.82, estimated fraction of usage for a conventional oven due to microwave oven usage.

E_{CO}=energy consumption as calculated in 4.1.2.1.1.

4.5.1.1.2 *Annual secondary energy consumption for a gas oven.* Calculate the annual secondary energy consumption for cooking of a gas oven in combination with a microwave oven, E_{SOM}, expressed in kilowatt-hours, with the following equation:

$$E_{SOM}=K \times E_{SO},$$

where:

K=0.82, as defined in 4.5.1.1.1.

E_{SO}=energy consumption as calculated in 4.1.2.1.2.

4.5.1.2 *Annual energy consumption of the conventional cooking top.* Calculate the annual energy consumption of a cooking top in combination with a microwave oven, E_{CAM}, expressed in kilowatt-hours for an electric cooking top and in Btu's for a gas cooking top, with the following equations:

For electric cooking tops:

$$E_{CAM}=L \times E_{CA},$$

where:

L=0.85, estimated fraction of usage for a conventional cooking top due to mircowave oven usage.

E_{CA}=energy consumption as calculated in 4.2.2.1.

For gas cooking tops:

$$E_{CAM}=(L \times E_{CC})+E_{PC},$$

where:

E_{CC}=annual energy consumption for coo ing as determined in 4.2.2.2.1.

E_{PC}=annual energy consumption of su face pilots as determined in 4.2.2.2.2.

L=0.85, as defined above.

4.5.1.3 *Total annual energy consumptio of microwave/conventional range.*

4.5.1.3.1 *Microwave/conventional ele tric range.* Calculate the total annu energy consumption of all-electric micro wave/conventional range, E_{RM}, expressed i kilowatt-hours per year with the followin equation:

$$E_{RM}=E_{COM}+E_{SC}+E_{CL}+E_{CAM}+E_{MO},$$

where:

E_{COM}=primary energy consumption fo oven cooking as determined in 4.5.1.1.1.

E_{SC}=primary energy consumption for ove self-cleaning as determined in 4.1.2.3.1.

E_{CL}=conventional oven clock energy con sumption as determined in 4.1.2.4.

E_{CAM}=cooking top energy consumption a determined in 4.5.1.2.

E_{MO}=microwave oven energy consumptio as determined in 4.4.3.

4.5.1.3.2 *Microwave/conventional ga range.* For a microwave/conventional rang with a conventional gas cooking top and ga oven calculate the total annual gas con sumption, E_{RMG}, in Btu's and defined as:

$$E_{RMG}=E_{COM}+E_{SC}+E_{CAM}+E_{PO}+E_{PC},$$

where:

E_{COM}, E_{SC}, and E_{CAM} are the same as define in 4.5.1.3.1.

E_{PO}=gas oven pilot energy consumption a determined in 4.1.2.2.

E_{PC}=gas cooking top pilot energy con sumption as determined in 4.2.2.2.2.

Calculate the total annual electrical energ consumption, E_{RME}, in kilowatt-hours and de fined as:

$$E_{RME}=E_{MO}+E_{SOM}+E_{SS}+E_{CL},$$

where:

E_{MO}=microwave oven energy consumptio as determined in 4.4.3.

E_{SOM}=secondary energy consumption fo oven cooking as determined in 4.5.1.1.2.

E_{SS}=secondary energy consumption fo oven self-cleaning as determined i 4.1.2.3.2.

E_{CL}=conventional oven clock energy con sumption as determined in 4.1.2.4.

The total annual energy consumption of a gas and electric microwave/conventional range, E_{RM}, is comprised of E_{RMG}, expressed in Btu's, and E_{RME}, expressed in kilowatt hours, as computed above.

4.5.2. *Cooking efficiency of microwave/conventional range.* Calculate the cooking efficiency of a microwave/conventional range, Eff_{RM}, and defined as:

$$Eff_{RM} = \frac{1}{\frac{0.1250}{Eff_{AO}} + \frac{0.7643}{Eff_{CT}} + \frac{0.1107}{EFF_{MO}}},$$

where:

Eff_{AO}=cooking efficiency of conventional oven as determined in 4.1.3.1.

Eff_{CT}=cooking efficiency of the cooking top as determined in 4.2.1.3.

Eff_{MO}=microwave oven cooking efficiency as determined in 4.4.2.

The constants 0.1250, 0.7643 and 0.1107 are the fractions of total annual useful energy output represented by conventional oven usage, cooking top usage, and microwave oven usage respectively.

4.5.3. *Energy factor of microwave/conventional range.* Calculate the energy factor of a microwave/conventional range, R_{RM}, and defined as:

For all-electric ranges,

$$R_{RM} = \frac{O_{RM}}{E_{RM}},$$

where:

O_{RM}=308.9 kWh, annual useful cooking energy output.

E_{RM}=total annual energy consumption as determined in 4.5.1.3.1.

For ranges which use both gas and electrical energy,

$$R_{RM} = \frac{O_{RM}}{(E_{RME} \times H_e) + E_{RMG}},$$

where:

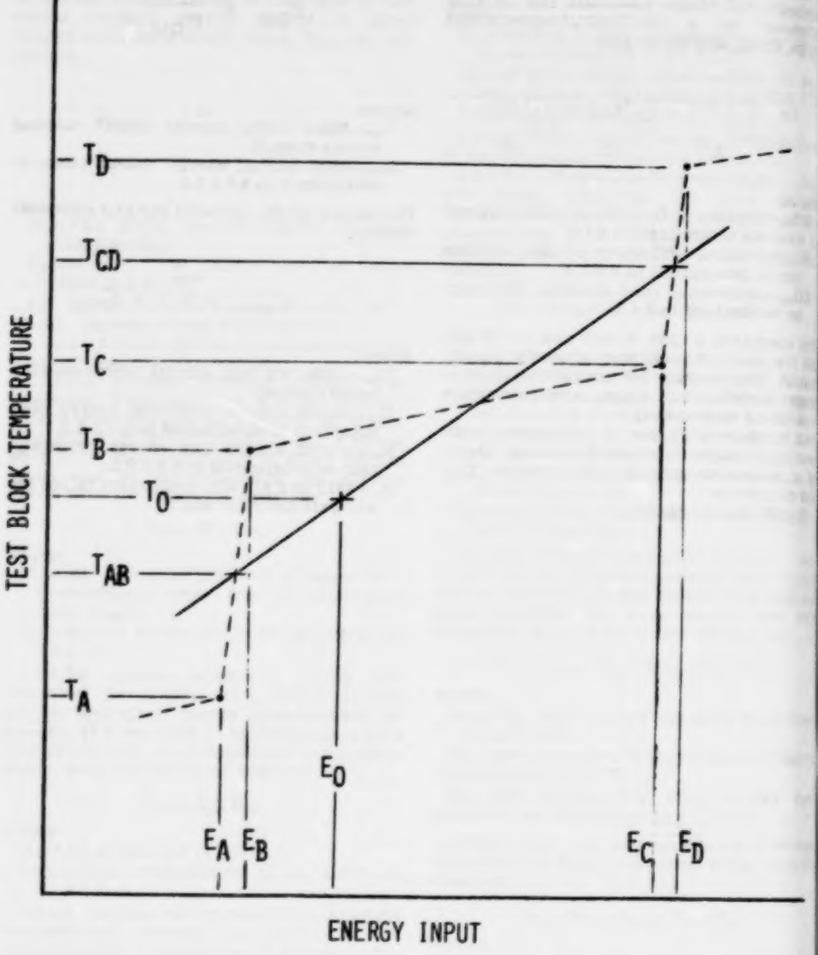
O_{RM}=1,054,000 Btu, annual useful cooking energy output.

E_{RME}=total annual electrical energy consumption as determined in 4.5.1.3.2.

E_{RMG}=total annual gas energy consumption as determined in 4.5.1.3.2.

H_e=3412 Btu's/kWh, conversion factor for kilowatt-hours to Btu's.

5. ILLUSTRATION OF CONVENTIONAL OVEN TEST DATA



(Energy Policy and Conservation Act, Pub. L. 94-163, as amended by Pub. L. 94-385, Pub. L 95-619; Federal Energy Administration Act of 1974, Pub. L. 93-275, as amended by Pub. L 94-385; Department of Energy Organization Act, Pub. L. 95-91; E.O. 11790, 39 FR 23185)

[43 FR 20120, May 10, 1978, as amended at 44 FR 22418, Apr. 13, 1979. Redesignated an amended at 44 FR 37938, June 29, 1979]

Appendix J to Subpart B of Part 430—Uniform Test Method for Measuring the Energy Consumption of Automatic and Semi-automatic Clothes Washers

1. DEFINITIONS

1.1 "AHAM" means the Association of Home Appliance Manufacturers.

1.2 "Bone-dry" means a condition or a load of test cloth which has been dried in a dryer at maximum temperature for a minimum of 10 minutes, removed and weighed before cool down, and then dried again for 10 minute periods until the final weight change of the load is 1 percent or less.

1.3 "Clothes container" means the compartment within the clothes washer that holds the clothes during the operation of the machine.

1.4 "Compact" refers to a clothes washer which has a clothes container capacity of less than 1.6 cubic feet.

1.5 "Deep rinse cycle" refers to a rinse cycle in which the clothes container is filled with water to a selected level and the clothes load is rinsed by agitating it or tumbling it through the water.

1.6 "Front-loader" means a clothes washer which sequentially rotates or tumbles portions of the clothes load above the water level allowing the clothes load to fall freely back into the water. The principal axis of the clothes container is in a horizontal plane and the access to the clothes container is through the front of the machine.

1.7 "HWL—1" refers to the test standard published by the AHAM and titled "American National Standard Z224.1-1971 Performance Evaluation Procedure for Household Clothes Washers," December 1971 designated at HLW-1.

1.8 "HLW-2EC" means AHAM "Test Method for Measuring Energy Consumption on Household Clothes Washers," December 1975, designated as HLW-2EC.

1.9 "Make-up water" means the amount of fresh water needed to supplement the amount of stored water pumped from the external laundry tub back into the clothes washer when the suds-return feature is activated in order to achieve the required water fill level in the clothes washer.

1.10 "Normal cycle" means the cycle recommended by the manufacturer for washing cotton and/or linen clothes.

1.11 "Sensor filled" refers to a type of water fill control which automatically terminates the fill control which automatically terminates the fill when the water reaches an appropriate level in the tub.

1.12 "Spray rinse cycle" refers to a rinse cycle in which water is sprayed onto the clothes load for a definite period of time without maintaining any specific water level in the clothes container.

1.13 "Standard" refers to a clothes washer which has a clothes container capacity of 1.6 cubic feet or greater.

1.14 "Suds-return" means a feature or option on a clothes washer which causes the stored wash water obtained by utilizing the suds-saver feature to be pumped from the external laundry tub back into the clothes washer.

1.15 Suds-saver" means a feature or option on a clothes washer which allows the user to store used wash water in an external laundry tub for use with subsequent wash loads.

1.16 "Temperature use factor" means the percentage of the total number of washes a user would wash with a particular wash/rinse temperature setting.

1.17 "Time filled" refers to a type of water fill control which uses a combination of water flow control in conjunction with time to terminate the water fill cycle.

1.18 "Top-loader" means a clothes washer that flexes and oscillates the submerged clothes load through the water by mean of mechanical agitation or other movement. The principal axis of the clothes container is in a vertical plane and the access to the clothes container is through the top of the clothes washer.

2. TESTING CONDITIONS

2.1 *Installation.* Install the clothes washer in accordance with manufacturer's instructions.

2.2 *Electrical energy supply.* Maintain the electrical supply to the clothes washer at 120 volts ±2 volts. Disconnect all console lights or other lighting systems on the clothes washer which do not consume more than 10 watts during the clothes washer test cycle.

2.3 *Water temperature.* The temperature of the water supply shall be maintained at 100° F ±10° F for all clothes washers not equipped with thermostatically controlled inlet water valves. For clothes washers equipped with thermostatic valves, the temperature of the hot water supply shall be maintained at 140° F ±5° F and the cold water supply shall be maintained at 60° F ±5° F. The water meter shall be installed in both the hot and cold water lines to measure water consumption.

2.4 *Water pressure.* The dynamic water pressure at the hot and cold water inlet connection of the machine shall be equalized at 35 pounds per square inch gauge (psig) ±2.5 psig. The dynamic water pressure for a single water inlet connection shall be maintained at 35 psig ±2.5 psig. The water pressure gauge shall be installed in both the hot and cold water lines to measure water pressure.

2.5 *Instrumentation.* Perform all test measurements using the following instruments, as appropriate:

2.5.1 *Weighing scales.*

2.5.1.1 *Weighing scale for test cloth.* The scale shall have a range of 0 to a maximum of 30 pounds with a resolution of at least 0.2 ounces and a maximum error no greater than 0.3 percent of any measured value within the range of 3 to 15 pounds.

2.5.1.2 *Weighing scale for clothes container capacity measurements.* The scale should have a range of 0 to a maximum of 500 pounds with a resolution of 0.50 pounds and a maximum error no greater than 0.5 percent of the measured value.

2.5.2 Watt-hour meter. The watt-hour meter shall have a resolution of no larger than 1 watt-hour and a maximum error no greater than 2 percent of the measured value for any demand greater than 50 watts per hour.

2.5 *Thermometer.* The thermometer shall have an error no greater than ±1° F over the range of 32° F to 200° F.

2.5.4 *Water meter.* The water meter shall have a resolution no larger than 0.1 gallons and a maximum error no greater than 2 percent for all water flow rates from 1 to 5 gallons per minute.

2.5.5 *Water pressure gauge.* The water pressure gauge shall have a resolution of 1 pound per square inch gauge (psig) and shall have an error no greater than 5 percent of any measured value over the range of 32.5 to 37.5 psig.

2.6 *Test cloths.*

2.6.1 *Energy test cloth.* The energy test cloth shall be clean and consist of the following:

(a) Pure finished bleached cloth, made with a momie or granite weave, which is 50 percent cotton and 50 percent polyester and weighs 5.75 ounces per square yard and has 65 ends on the warp and 57 picks on the fill.

(b) Cloth material that is 24 inches by 36 inches and has been hemmed to 22 inches by 34 inches before washing. The maximum shrinkage after five washes shall not be more than four percent on the length and width.

(c) The number of test runs on the same energy test cloth shall not exceed 25 runs.

2.6.2 *Energy stuffer cloths.* The energy stuffer cloths shall be made from energy tests cloth material and shall consist of pieces of material that are 12 inches by 12 inches and have been hemmed to 10 inches by 10 inches before washing. The maximum shrinkage after five washes shall not be more than four percent on the length and width. The number of test runs on the same energy stuffer cloth shall not exceed 25 runs.

2.7 *Composition of test loads.*

2.7.1 *Seven pound test load.* The seven pound test load shall consist of bone-dry energy test cloths which weigh 7 pounds ±0.07 pounds. Adjustments to the test load to achieve the proper weight can be made by the use of energy stuffer cloths.

2.7.2 *Three pound test load.* The three pound test load shall consist of bone-dry energy test cloths which weigh 3 pounds ±0.03 pounds. Adjustments to the test load to achieve the proper weight can be made by the use of energy stuffer cloths.

2.8 *Use of test loads.*

2.8.1 *Top-loader clothes washer.* The top-loader clothes washer shall be tested without a test load.

2.8.2 *Front-loader clothes washer.*

2.8.2.1 *Standard size front-loader clothes washer.* When the maximum water fill level is being tested, the test load shall be seven pounds as described in 2.7.1. When the minimum water fill level is being tested, the test load shall be three pounds as described in 2.7.2.

2.8.2.2 *Compact size front-loader clothes washer.* When either the maximum or minimum fill levels are being tested, the test load shall be three pounds as described in 2.7.2.

2.8.3 *Method of loading.* Load the energy test cloths by grasping them in the center, shaking them to hang loosely and then dropping them into the clothes container prior to activating the clothes washer.

2.9 *Preconditioning.* If the clothes washer has not previously been tested nor filled with water in the preceding 96 hours, precondition it by running it through a cold rinse cycle and then draining it to insure that the hose, pump, and sump are filled with water.

2.10 *Clothes washer setting.* Set the wash time for approximately 10 minutes, but the actual wash time (period of agitation) shall not be less than 9.75 minutes. Where controls are provided for agitation and spin speed, set them for the normal cycle.

3. TEST MEASUREMENTS

3.1 *Clothes container capacity.* Measure the entire volume which a dry clothes load could occupy within the clothes container according to the procedures described in 3.1.1 and 3.1.2.

3.1.1 *Top-loaders clothes washers.* Line the clothes container with 2 mil plastic sheet or use some other method to prevent the water from entering the outer tub container. The agitator shall be in place. Fill the clothes container with water to its uppermost edge, (This filling procedure may require overriding of the fill level control, or manually completing the fill to the top of the container after the fill sensor terminates the fill at maximum level.) Record the weight of the machine before filling it with water and then after filling it with water

The clothes container capacity is calculated as follows:

C=W/d.

C=Capacity in cubic feet.

W=Mass of water in pounds.

d=Density of water at the measured temperature in pounds per cubic foot (at 140° F).

3.1.2 *Front-loader clothes washer.* Position the tub and shaft axis vertically with the shaft downward. Line the clothes container with 2 mil plastic sheet or use some other method to prevent the water from entering the outer tub container. The agitator shall be in place. Fill the clothes container with water to its uppermost edge. (This filling procedure may require overriding of the fill level control, or manually completing the fill to the top of the container after the fill sensor terminates the fill at maximum level.) Record the weight of the machine before filling it with water and then after filling it with water. The clothes container capacity is calculate as follows:

C=W/d

C=Capacity in cubic feet.

W=Mass of water in pounds.

d=Density of water at the measured temperature in pounds per cubic foot (at 140° F).

3.2 *Test cycle.* Establish the testing conditions set forth in 2 of this Appendix.

3.2.1 *Per-cycle electrical energy consumption.* Set the water level selector at a maximum fill and insert the appropriate test load, if applicable. Activate the normal cycle of the clothes washer and also any suds-saver switch.

3.2.1.1 Measure the electrical energy consumption of the clothes washer for a complete normal cycle.

3.2.2 *Hot water consumption for a normal cycle with the water level selector at maximum fill.*

3.2.2.1 Set the water level selector at maximum fill and insert the appropriate test load, if applicable. Activate the normal cycle of the clothes washer and also any suds-saver switch.

3.2.2.2 For automatic clothes washers set the wash/rinse temperature selector to the hottest setting available (hot/warm). For semi-automatic clothes washers open the hot water faucet valve completely and close the cold water faucet valve to achieve the hottest setting (hot/hot).

3.2.2.3 Measure the number of gallons of hot water used to fill the tub for the wash cycle.

3.2.2.4 Measure the total number of gallons of hot water used for all deep rinse cycles.

3.2.2.5 Measure the total gallons of hot water used for all spray rinse cycles.

3.2.2.6 For automatic clothes washers repeat 3.2.2.3, 3.2.2.4, and 3.2.2.5 for each of the other wash/rinse temperature selections available that use hot water. For semi-automatic clothes washers repeat 3.2.2.3, 3.2.2.4, and 3.2.2.5 for Hot/Cold, Warm/Cold, Warm/Warm, and Warm/Cold temperature settings with the following water faucet valve adjustments:

	Faucet position	
	Hot valve	Cold valve
Hot	Completely open	Closed.
Warm	do	Completely open.
Cold	Closed	Do.

3.2.2.7 Set the suds-saver switch to activate the sud-return. Repeat 3.2.2.2 to 3.2.2.5 for a warm/cold temperature setting.

3.2.3 *Hot water consumption for a normal cycle with the water level selector at minimum fill.* Set the water level selector at minimum fill and insert the appropriate test load, if applicable. Activate the normal cycle of the clothes washer and also any suds-saver switch. Repeat 3.2.2.2 through 3.2.2.7.

3.2.4 *Hot water consumption for clothes washers that incorporate a partial fill during the rinse cycle.* Where the procedures in 3.2.2 and 3.2.3 cannot be used for clothes washers that incorporate a partial fill during the rinse cycle, activate any suds-saver switch and operate the cloths washer for the complete normal cycle at both the maximum water fill level and the minimum water fill level for each of the wash/rinse temperature selections available that use hot water. Measure the total hot water consumed during the complete normal cycle.

3.3 *Data recording.* Record for each test cycle in 3.2.

3.3.1 Total the kilowatt-hours of electrical energy, M_E, consumed during the test to operate the clothes washer in 3.2.1.

3.3.2 Total the hot water measured at maximum fill level for each wash/rinse temperature selection, V_h, excluding any fresh make-up water required to complete the fill during a suds-return cycle.

3.3.3 Total the hot water measured at minimum fill level for each wash/rinse temperature selection, V_l, excluding any fresh make-up water required to complete the fill during a suds-return cycle.

3.3.4 Total the hot water measured at maximum fill for the suds-return cycle, S_h.

3.3.5 Total the hot water measured at minimum fill for suds-return cycle, S_L.

4. CALCULATION OF DERIVED RESULTS FROM TEST MEASUREMENTS

4.1 *Per-cycle temperature-weighted hot water consumption for maximum and mini-*

mum water fill levels. Calculate for the cycle under test the per-cycle temperature-weighted hot water consumption for the maximum water fill level, V_{max}, and for the minimum water fill level, V_{min}, expressed in gallons per cycle and defined as:

$$V_{max}=X_1 \Sigma_{i=1}^{n} [V_i \times TUF_i]+X_2[TUF_w \times S_n]$$

where

V_i=Reported hot water consumption in gallons per-cycle at maximum fill for each wash/cycle temperature selection, as provided in 3.2.2.

TUF_i=Applicable temperature use factor corresponding to wash/rinse temperature selection as shown in 5 or 6.

n=Number of wash/rinse temperature selections available to the user for the clothes washer under test.

TUF_w=Temperature use factor for warm wash setting.

For clothes washers equipped with suds-saver feature:

X_1=Frequency of use without suds-saver feature=.86.

X_2=Frequency of use with suds-saver feature=.14.

For clothes washers not equipped with suds-saver feature:

X_1=1.0

X_2=0.0

S_n=Fresh make-up water measured during suds-return cycle at maximum water fill level.

and

$$V_{min}=X_1 \Sigma_{j=1}^{n} [V_i \times TUF_i]+X_2[TUF_w \times S_L]$$

where

V_i=Reported hot water consumption in gallons per cycle at minimum fill for each wash/rinse temperature selection, as provided in 3.3.3.

TUF_i=Applicable temperature factor corresponding to wash/rinse temperature selection as shown in 5 or 6.

S_L=Fresh make-up water measured during suds-return cycle at minimum water fill level.

n=As defined above.

TUF_w=As defined above.

X_1=As defined above.

X_2=As defined above.

4.2 *Total per-cycle hot water energy consumption for maximum and minimum water fill levels.* Calculate the total per-cycle hot water energy consumption for the maximum water fill level, E_{max} and for the minimum water level, E_{min}, expressed in kilowatt-hours per cycle and defined as:

$$E_{max}=[V_{max} \times T \times K \times MF]$$

where

MF=Multiplying factor to account for the absence of a test load=0.94 for top-loader clothes washers that are sensor filled, 1.0 for top-loader clothes washers that are time filled, and 1.0 for all front-loader clothes washers.

T=Temperature rise=90° F.

K=Water specific heat in kilowatt-hours per gallon degree F=0.00240.

V_{max}=As defined in 4.1.

and

$$E_{min}=[V_{min} \times T \times K \times MF]$$

where

MF=As defined above.

T=As defined above.

K=As defined above.

V_{min}=As defined in 4.1.

4.3 *Total weighted per-cycle hot water energy consumption expressed in kilowatt-hours.* Calculate the total weighted per-cycle hot water energy consumption, E_T, expressed in kilowatt-hours per cycle and defined as:

$$E_T=[E_{max} \times F_{max}]+[E_{min} \times F_{min}]$$

where

F_{max}=Usage fill factor=0.72.

F_{min}=Usage fill factor=0.28.

E_{max}=As defined in 4.2.

E_{min}=As defined in 4.2.

4.4 *Per-cycle machine electrical energy consumption.* The value recorded in 3.3.1 is the per-cycle machine electrical energy consumption, M_E, expressed in kilowatt-hours per cycle.

4.5 *Per-cycle water energy consumption using gas-heated or oil-heated water.* Calculate for the normal cycle the per-cycle water consumption, E_{TG}, using gas heated or oil-heated water, expressed in Btu per cycle and defined as;

$$E_{TG}=E_T \times 1/e \times 3412\ Btu/Kwh.$$

where

e=Nominal gas or oil water heater efficiency=0.75.

E_T=As defined in 4.3.

4.6 *Total per-cycle energy consumption when electrically heated water is used.* Calculate for the normal cycle the total per-cycle energy consumption, E_{TE}, using electrically heated water, expressed in kilowatt-hours per cycle and defined as:

$$E_{TE}=E_T+M_E$$

M_E=As defined in 4.4

E_T=As defined in 4.3.

5. APPLICABLE TEMPERATURE USE FACTORS FOR DETERMINING HOT WATER USAGE FOR VARIOUS WASH/RINSE TEMPERATURE SELECTIONS FOR ALL AUTOMATIC CLOTHES WASHERS

5.1 *Five temperature selection* ($n=5$).

Wash/rinse temperature setting	Temperature use factor (TUF)
Hot/warm	0.18
Hot/cold	.12
Warm/warm	.30
Warm/cold	.25
Cold/cold	.15

5.2 *Four temperature selection (n=4).*

Wash/rinse temperature setting	Temperature use factor (TUF)
Alternate I:	
Hot/warm	0.18
Hot/cold	.12
Warm/cold	.55
Cold/cold	.15
Alternate II:	
Hot/warm	0.18
Hot/cold	.12
Warm/warm	.30
Warm/cold	.40
Alternate III:	
Hot/cold	0.12
Warm/warm	.18
Warm/cold	.55
Cold/cold	.15

5.3 *Three temperature selection (n=3).*

Wash/rinse temperature setting	Temperature use factor (TUF)
Alternate I:	
Hot/warm	0.30
Warm/cold	.55
Cold/cold	.15
Alternate II:	
Hot/cold	0.30
Warm/cold	.55
Cold/cold	.15
Alternate III:	
Hot/cold	0.30
Warm/warm	.55
Cold/cold	.15

6. APPLICABLE TEMPERATURE USE FACTORS FOR DETERMINING HOT WATER USAGE FOR VARIOUS WASH/RINSE TEMPERATURE SETTINGS FOR ALL SEMI-AUTOMATIC CLOTHES WASHERS

6.1 *Six temperature settings (n=6).*

Wash/rinse temperature setting	Temperature use factor (TUF)
Hot/hot	0.15
Hot/warm	.09
Hot/cold	.06
Warm/warm	.42
Warm/cold	.13
Cold/cold	.15

[42 FR 49807, Sept. 28, 1977. Redesignated and amended at 44 FR 37938, June 29, 1979]

APPENDIX K1 TO SUBPART B OF PART 430—UNIFORM TEST METHOD FOR MEASURING THE ENERGY CONSUMPTION OF CENTRAL SYSTEM HUMIDIFIERS

1. DEFINITIONS

1.1 "ARI" means the Air-Conditioning and Refrigeration Institute.

1.2 "ARI 610-74" means the test standard published by the ARI, titled "Standard for Central System Humidifiers," 1974, and designated as ARI 610-74.

1.3 "By-pass humidifier" means a central system humidifier in which the air for humidification is taken from the heated air of the furnace plenum and drawn through a wetted element by the pressure differential of the furnace blower system.

1.4 "Humidification rate" means a measure of the ability of a humidifier to add moisture to its surrounding atmosphere expressed as the number of gallons of water evaporated per 24 hours of continuous operation.

1.5 "Seasonal performance factor" means the ratio of the seasonal energy output of a heating system delivered to the conditioned space, in Btu's divided by the seasonal energy input to the heating system, in Btu's.

1.6 "Humidistat" means a device which requires no user intervention and which is used to enable a humidifier to maintain a constant relative humidity of the conditioned air.

2. TESTING CONDITIONS

2.1 *Installation.* Install the humidifier according to manufacturer's instructions and in accordance with section A4 of ARI 610-74. In the event of a conflict between the manufacturer's instructions and ARI 610-74, the provision of ARI 610-74 shall control.

2.2 *Energy flow instrumentation.* Install energy flow instrumentation or other instrumentation as appropriate, in accordance with section A3 of ARI 610-74. A wattmeter shall be installed in the electrical circuit when a humidifier is connected to an electrical supply circuit.

2.3 *Temperature instrumentation.* Use mercury-in-glass thermometers that are accurate to within 0.1° F to measure both the wet bulb and dry bulb temperature. The smallest graduation on the thermometers is to represent a maximum of 0.2° F.

3. TESTING AND MEASUREMENTS

3.1 *Humidification rate.* Determine the humidification rate, H_w, of the humidifier under test, in gallons per day, according to the methods and calculations specified in sections A5 and A6 of ARI 610-74.

3.2 *Input power.* Measure the input power (P) to the humidifier, in watts, when the humidifier is operating under full load conditions.

3.3 *By-pass air flow rate determination for by-pass humidifiers.* The air flow rate through the by-pass humidifier (V_b) shall be measured in cubic feet per minute using air flow nozzles in accordance with Figure A1 described in paragraph A3.3.1 and static pressure taps in accordance with paragraph A3.3.2 of ARI 610-74.

The humidifier shall be mounted to a plenum attached to the outlet of a fan capable of delivering the required air flow for the conditions of the test in accordance with 6 of this Appendix. The by-pass duct of the humidifier shall be connected to the inlet of the air measuring duct (AMD). The temperature of the air shall be room temperature, 70° F ±10° F, 30 percent relative humidity, and the static pressure in the duct between the fan and humidifier shall be adjusted to 0.2 in. water differential. The pressure drop across the nozzle shall be recorded and the air volume calculated using the equations of A6.1.1 and A6.1.2 of ARI 610-74.

3.4 *Temperature measurement.* The temperature of the water entering the humidifier shall be maintained at 60° F ±2° F. The waste water temperature from the humidifier shall be measured and recorded. No less than five sets of readings shall be taken.

4. CALCULATION OF DERIVED RESULTS FROM TEST MEASUREMENTS

4.1 *Average annual electric furnace or electric resistance heating energy consumption.* Calculate the average annual electric furnace or electric resistance heating energy consumption, E_{f-e}, expressed in kilowatt-hours per year, to vaporize water to maintain a room relative humidity of 30 percent at a room temperature of 70° F, and defined as:

$$E_{f-e}=(Q_o+Q_w-3412E_s/SPF_e)\,(1/3412),$$

where

Q_o = average annual energy output of the humidifier in terms of heat of vaporization, in Btu's,

$=[N\times H_w(8.34\times 1060)/24]$,

where

N = 700 hours per year for units with humidistats, or 1600 hours per year for units without humidistats, the representative average-use cycle of humidifier operation

H_w = humidification rate determined in accordance with 3.1 of this Appendix, in gallons per day

8.34 = conversion factor to convert gallons of water to pounds of water

1060 = heat of vaporization of water in Btu's per pound (Based on a water temperature of 60° F).

24 = conversion factor to convert days to hours

SPF_e = 1.0, seasonal performance factor of electric furnace or electric resistance heating dimensionless

Q_w = average annual energy lost in waste water from the humidifier housing or sump, in Btu's per year,

$=N\times q_w$,

where

N as defined above, and

q_w = rate of waste water energy lost, in Btu's per hour

$=W\times C\times\Delta t$,

where

W = measured waste water drainoff rate, in pounds per hour, consisting of the water quantity determined in accordance with section A5.6.2.4 of ARI 610-74, over the time period of the test.

C = 1, specific heat of water, in Btu's per pound—degree Fahrenheit

Δt = waste water temperature rise, in degrees Fahrenheit

$=t_{out}-60°$ F

3412 = conversion factor to convert kilowatt-hours to Btu's

E_s as defined in 4.2 of this Appendix.

4.2 *Average annual supplementary electrical energy consumption.* Calculate the average annual supplementary electrical energy consumption, E_s, expressed in kilowatt-hours per year, and defined as:

$$E_s=(E_p+E_b/1000),$$

where

E_p = average annual electric energy consumption to operate the humidifier determined in accordance with section 3.2 of this Appendix, in watt-hours per year

$=N\times P$,

where

N as defined in 4.1

P as determined in 3.2

E_b = additional equivalent electric energy required by the furnace fan for by-

pass type humidifiers, in watt-hours per year
$=0.365\ V_b \times N$,

where
V_b=by-pass flow rate determined in accordance with section 3.3 of this Appendix, in cubic feet per minute
0.365=furnace fan power to operate by-pass humidifier, in watts per cubic feet per minute
N as defined in 4.1.

4.3 *Average annual electric heat pump energy consumption.* Calculate the average annual electric heat pump energy consumption, E_{F-HP}, expressed in kilowatt-hours per year, to vaporize water to maintain a room relative humidity of 30 percent at a room temperature of 70° F, and defined as:

$$E_{F-HP}=(Q_s+Q_v-3412\ E_s/SPF_{HP})\ (1/3412),$$

where
SPF_{HP}=1.5, seasonal performance factor of electric heat pump, dimensionless
3412 as defined in 4.1
Q_s as defined in 4.1
Q_v as defined in 4.1
E_s as defined in 4.2

4.4 *Average annual gas furnace energy consumption.* Calculate the average annual gas furnace energy consumption, E_{F-G}, expressed in Btu's per year, to vaporize water to maintain a room relative humidity of 30 percent at a room temperature of 70° F, and defined as:

$$E_{F-G}=(Q_s+Q_v-3412\ E_s/SPF_G),$$

where
SPF_G=.65, seasonal performance factor of gas furnace, dimensionless
Q_s as defined in 4.1
Q_v as defined in 4.1
E_s as defined in 4.2
3412 as defined in 4.1

4.5 *Average annual oil furnace energy consumption.* Calculate the average annual oil furnace energy consumption, E_{F-O}, expressed in Btu's per year, to vaporize water to maintain a room relative humidity of 30 percent at a room temperature of 70° F, and defined as:

$$E_{F-O}=(Q_s+Q_v-3412E_s/SPF_O),$$

where
SPF_O=.75, seasonal performance factor of oil furnaces, dimensionless
3412 as defined in 4.1
Q_s as defined in 4.1
Q_v as defined in 4.1
E_s as defined in 4.2

4.6 *Hourly humidification rate.* Calculate the hourly humidification rate, H_{wh}, expressed in pounds per hour, and defined as:

$$H_{wh}=8.34\ H_w/24$$

where
H_w as defined in 4.1
8.34 as defined in 4.1
24 as defined in 4.1

4.7 *Hourly rate of electrical energy input.* Calculate the hourly rate of electrical energy input, q_p expressed in Btu's per hour, and defined as:

$$q_p=3.412\ P,$$

where
P as determined in 3.2
3.412=conversion factor to convert watts to Btu's per hour.

4.8 *Hourly rate of equivalent electrical energy input for by-pass humidifiers.* Calculate the hourly rate of equivalent electrical energy input for by-pass humidifiers, q_b, expressed in Btu's per hour, and defined as:

$$q_b=0.365\ V_b \times 3.412,$$

where
0.365 as defined in 4.2
V_b as defined in 4.2
3.412 as defined in 4.7

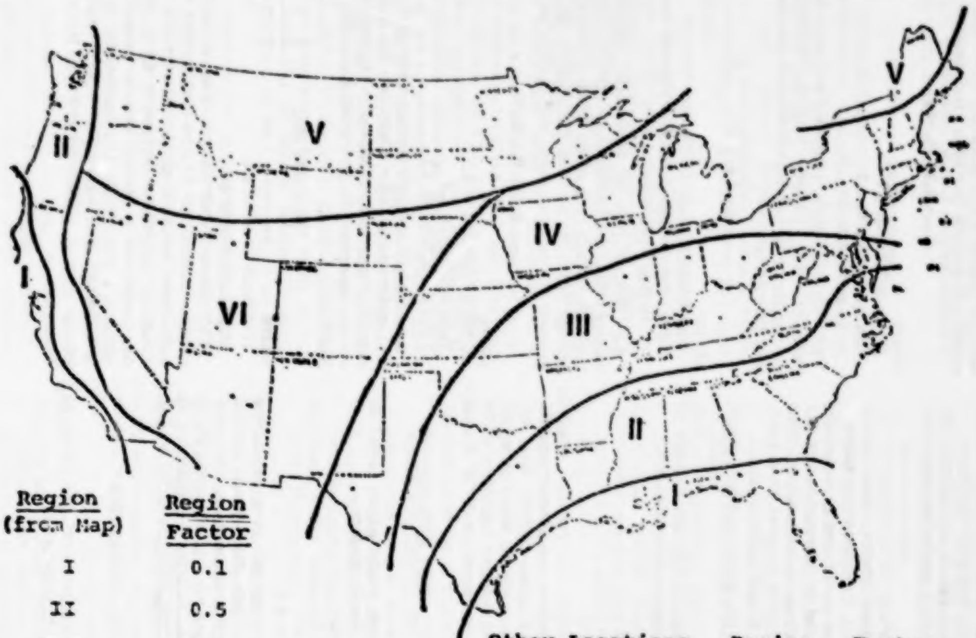
4.9 *Hourly rate of energy output of a central system humidifier.* Calculate the hourly rate of energy output of a central humidifier, H_o, expressed in Btu's per hour and defined as:

$$H_o=1060\ H_{wh},$$

where
1060 as defined in 4.1.
H_{wh} as defined in 4.6.

4.10 *Humidistat factor.* For a central system humidifier with a humidistat, the humidistat factor is equal to the hourly rate of energy output, as defined in 4.9, in Btu's per hour. For a central system humidifier without a humidistat, the humidistat factor is equal to 2.29 times the hourly rate of energy output, as defined in 4.9, in Btu's per hour.

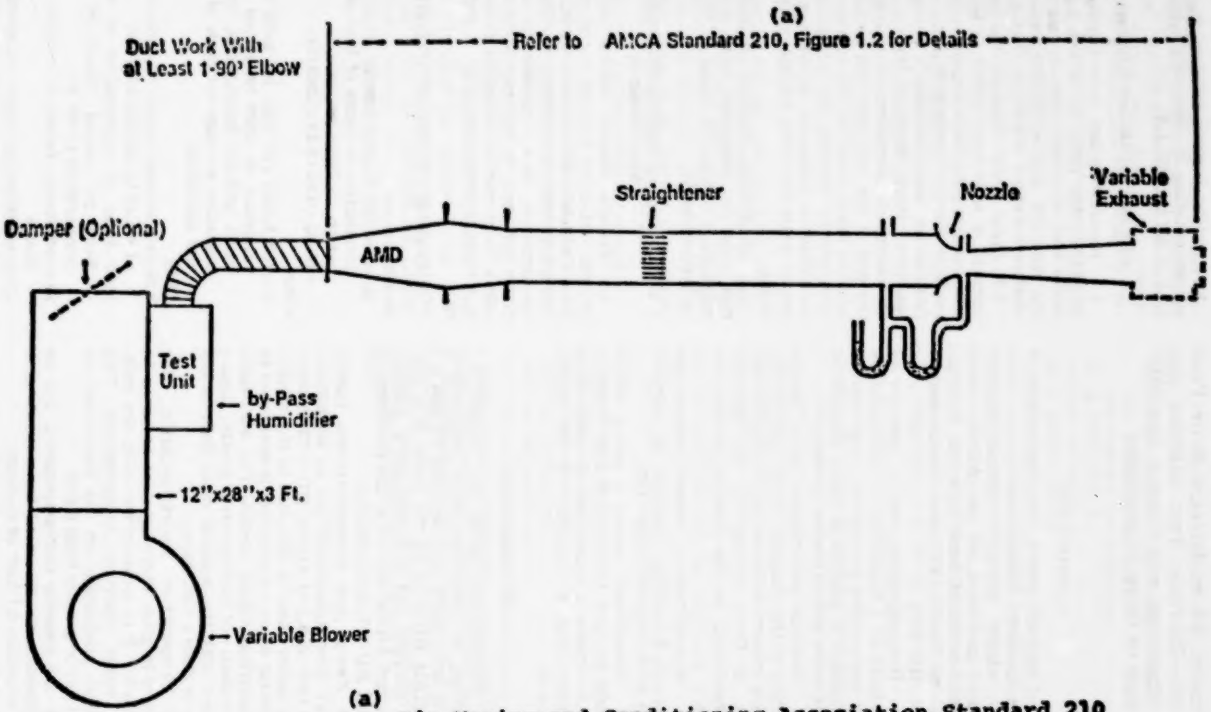
5. Regional factors for adjusting the humidity loads of the respectiv region:



	Region (from Map)	Region Factor
5.1	I	0.1
5.2	II	0.5
5.3	III	1.0
5.4	IV	1.5
5.5	V	2.0
5.6	VI	2.5

Other Locations	Region	Factor
Alaska	VI	2.5
Hawaii	0	0.0
Territories	0	0.0

6. Installation of by-pass humidifiers.


(a)
Duct Work With at Least 1-90° Elbow
Refer to AMCA Standard 210, Figure 1.2 for Details
Damper (Optional)
AMD
Straightener
Nozzle
Variable Exhaust
Test Unit
by-Pass Humidifier
12"x28"x3 Ft.
Variable Blower

(a) **Air Moving and Conditioning Association Standard 210**

[42 FR 27898, June 1, 1977. Redesignated and amended at 44 FR 37938, June 29, 1979]

APPENDIX K2 TO SUBPART B OF PART 430—UNIFORM TEST METHOD FOR MEASURING THE ENERGY CONSUMPTION OF ROOM HUMIDIFIERS

1. DEFINITIONS

1.1 "AHAM" means the Association of Home Appliance Manufacturers.

1.2 "AHAM HU-1-72" means the test standard published by the AHAM, titled "Appliance Humidifiers" American National Standard Z235.1-1972, and designated as AHAM HU-1-72.

1.3 "Humidification rate" a measure of the ability of a humidifier to add moisture to its surrounding atmosphere expressed as the number of gallons of water evaporated per 24 hours of continuous operation.

1.4 "Seasonal performance factor" means the ratio of the seasonal energy output of a heating system delivered to the conditioned space, in Btu's, divided by the seasonal energy input to the heating system, in Btu's.

1.5 "Humidification power" means the power, in kilowatts, required to vaporize water at the humidification rate.

1.6 "Humidistat" means a device which requires no user intervention and which is used to enable a humidifier to maintain a constant relative humidity of the conditioned air.

2. TEST CONDITIONS

2.1 *Installation.* Install the humidifier according to manufacturer's instructions and in accordance with sections 5.2 and 5.3 of AHAM HU-1-72. In the event of a conflict between the manufacturer's instructions and AHAM HU-1-72, the provision of AHAM HU-1-72 shall control.

2.2 *Energy flow instrumentation.* Install energy flow instrumentation in accordance with section 5.1 of AHAM HU-1-72. A watt-hour meter shall be installed in the electrical circuit when a humidifier is connected to an electrical supply circuit. The watt-hour meter shall not have an error greater than 1 percent with the smallest scale division not greater than 1 watt-hour.

2.3 *Temperature instrumentation.* Use mercury-in-glass thermometers accurate to within 0.1° F to measure wet bulb, dry bulb, and water reservoir temperatures. The smallest graduation on the thermometers shall not be greater than 0.2° F.

2.4 *Air pressure instrumentation.* Use an air pressure measurement instrument accurate to within 0.1 inch of mercury.

2.5 *Time instrumentation.* Use time instrumentation in acordance with section 5.1.4 of AHAM HU-1-72.

2.6 *Weight instrumentation.* Use weig instrumentation in accordance with sectio 5.1.5 of AHAM HU-1-72.

3. TEST PROCEDURES AND MEASUREMENTS

3.1 *Humidification rate.* Determine th humidification rate, Q, of the humidifie under test, in gallons per day, according t the methods and calculations specified i sections 5.2 and 6 of AHAM HU-1-72.

3.2 *Input power.* Connect the humidifie through a watt-hour meter in accordan with section 2.2 of this Appendix. Humidi ers with electric heaters shall be run wi heaters on and humidity controls set a maximum levels. Measure the total electr cal energy consumption, in watt-hours, a the end of the two hour test period. Calc late the input power to the humidifier, P, i kilowatts by dividing the two hour energ consumption measured in the test by 2 t obtain watts and then by 1000 to obtain ki owatt.

3.3 *Barometric Pressure.* Humidificatio rate shall be measured when barometr pressure is within the range of 29.9 inche (±1) of mercury.

4. CALCULATION OF DERIVED RESULTS FROM TH MEASUREMENTS

4.1 *Average annual electric furnace o electric resistance heating energy consum tion.* Calculate the average annual electri furnace or electric resistance heating energ consumption, E_{F-E}, expressed in kilowat hours per year, to vaporize water to mai tain a room relative humidity of 30 perce at a room temperature of 70° F, and defin as:

$$E_{F-E}=(Q_o-3412E_s/SPF_E)\,(1/3412),$$

where

Q_o=average annual energy output of th humidifier in terms of heat of vapo zation, in Btu's per year,

$=N\times Q\times 0.93\ (8.34\times 1060/24)$

where

N=700 hours per year for units with hu midistats, or 1600 hours per year fo units without humidistats, the repre sentative average-use cycle of humidi fier operation.

SPF_E

8.34=conversion factor to convert gallo of water to pounds of water

1060=heat of vaporization of water i Btu's per pound (Based on a wat temperature of 60° F)

24=conversion factor to convert days t hours

Q=humidification rate (water output c pacity) determined in accordance wi section 3.1 of this Appendix, in gallo per day.

0.93=correction factor to adjust the humidifier output at standard conditions of 75° F and 30 percent relative humidity to normal room conditions of 70° F and 30 percent relative humidity, dimensionless.

SPF_E=1.0, seasonal performance factor of electric furnace or electric resistance heating, dimensionless.

3412=conversion factor to convert kilowatt-hours to Btu's.

E_s as defined in 4.2

4.2 *Average annual supplementary elec- rical energy consumption.* Calculate the av- erage annual supplementary electrical nergy consumption, E_s, expressed in kilo- att-hours per year, and defined as:

$$E_s = N \times P,$$

here

N as defined in 4.1

P as determined in 3.2

4.3 *Average annual electric heat pump nergy consumption.* Calculate the average nnual electric heat pump energy consump- ion, E_{r-HP}, expressed in kilowatt-hours per ear, to vaporize water to maintain a room elative humidity of 30 percent at a room emperature of 70° F, and defined as:

$$E_{r-HP} = (Q_s - 3412E_s/SPF_{HP})\,(1/3412),$$

here

SPF_{HP}=1.5, seasonal performance factor of electric heat pump, dimensionless.

3412 as defined in 4.1

Q_s as defined in 4.1

E_s as defined in 4.2

4.4 *Average annual gas furnace, gas oiler, or unvented gas heater energy con- umption.* Calculate the average annual gas urnace, gas boiler, or unvented gas heater nergy consumption, E_{r-G}, expressed in tu's per year, and defined as:

$$E_{r-G} = Q_s - 3412E_s/SPF_G,$$

where

SPF_G=.65 seasonal performance factor of gas furnaces, gas boilers, or unvented gas heaters, dimensionless

Q_s as defined in 4.1

3412 as defined in 4.1

E_s as defined in 4.2

4.5 *Average annual oil furnace or oil boiler energy consumption.* Calculate the average annual oil furnace energy or oil boiler consumption, E_{r-o}, expressed in Btu's per year, to vaporize water to maintain a room relative humidity of 30 percent at a room temperature of 70° F, and defined as:

$$E_{r-o} = (Q_s - 3412E_s/SPF_o),$$

where

SPF_o=.75, seasonal performance factor of oil furnaces and oil boilers, dimensionless

3412 as defined in 4.1

Q_s as defined in 4.1

E_s as defined in 4.2

4.6 *Humidification power.* Calculate the humidification power, Q_H' expressed in kilowatts and defined as:

$$Q_H = (8.34 \times 1060 \times Q/24 \times 3412) = 0.107\ Q$$

where

Q as defined in 3.1

8.34 as defined in 4.1

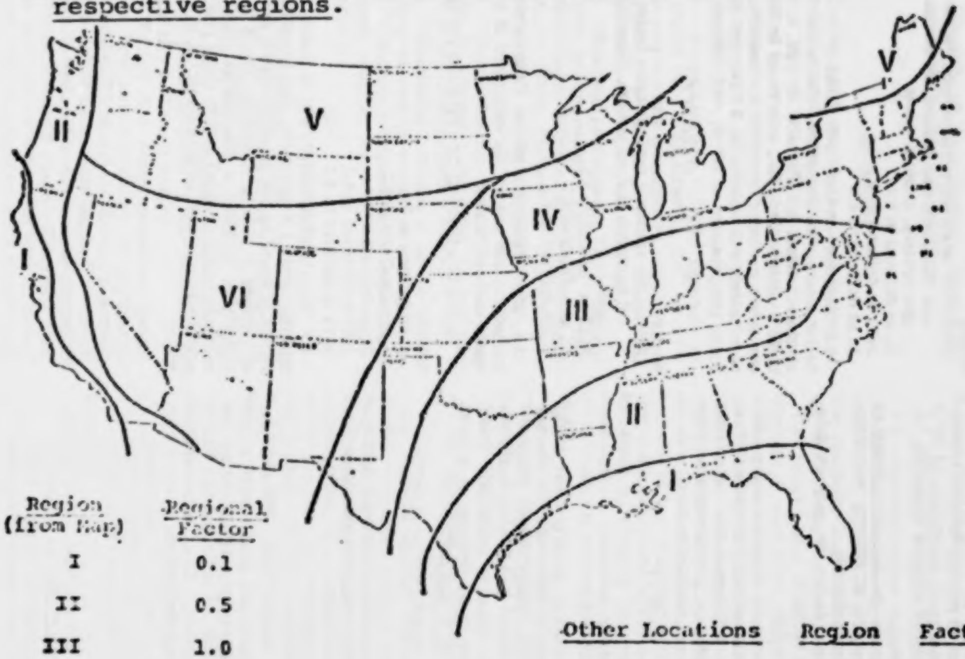
24 as defined in 4.1

1060 as defined in 4.1

3412 as defined in 4.1

4.7 *Humidistat factor.* For a room humidifier with a humidistat, the humidistat factor is equal to the humidification power, as defined in 4.6, in kilowatts. For a room humidifier without a humidistat, the humidistat factor is equal to 2.29 times the humidification power, as defined in 4.6, in kilowatts.

5. Regional factors for adjusting the humidity loads of the respective regions.



	Region (from Map)	Regional Factor
5.1	I	0.1
5.2	II	0.5
5.3	III	1.0
5.4	IV	1.5
5.5	V	2.0
5.6	VI	2.5

Other Locations	Region	Factor
Alaska	VI	2.5
Hawaii	0	0.0
Territories	0	0.0

(Energy Policy and Conservation Act, Pub. L. 94-163, as amended by Pub. L. 94-384; Feder Energy Administration Act of 1974, Pub. L. 93-275, as amended by Pub. L. 94-385; Depar ment of Energy Organization Act, Pub. L. 95-91; E.O. 11790, 39 FR 23185)

[42 FR 55604, Oct. 18, 1977. Redesignated and amended at 44 FR 37938, June 29, 1979]

APPENDIX L TO SUBPART B OF PART 430—UNIFORM TEST METHOD FOR MEASURING THE ENERGY CONSUMPTION OF DEHUMIDIFIERS

1. DEFINITIONS

1.1 "ANSI" means the American National Standard Institute.

1.2 "ANS B149.1-1972" means the test standard published by the ANSI, titled "American National Standard B149.1, Dehumidifiers", and designated as ANS B149.1-1972.

1.3 "Capacity" means a measure of the ability of a dehumidifier to remove moisture from its surrounding atmosphere.

1.4 "Rated capacity" means the amount of water, stated in pints, collected per 24 hours of continuous operation when tested in accordance with this Appendix.

2. TESTING CONDITIONS

2.1 Installation and Operational Conditions. Install the dehumidifier, and maintain the operating conditions, according to ANS B149.1-1972 as amended by section 3.1 of this Appendix. Install a watt-hour meter with an error not greater than 0.5 percent of the indicated value. The smallest scale graduation of the watt-hour meter shall not exceed one watt-hour.

3. TESTING AND MEASUREMENTS

3.1 Test. Perform a test by establishing the testing conditions set forth in section 2.1 of this Appendix, testing the dehumidifier in accordance with ANS B149.1-1972 sections 3, 4, 5, 6, and 7, except that paragraphs 5.1 and 6.3 of ANS B149.1-1972 shall be deleted.

3.2 Test Measurements. Measure the energy consumption (E), in kilowatt-hours (kWh) during the test performed according to section 3.1 and perform the measurements specified in section 7 of ANS B149.1-1972.

3.3 Recorded Values. Record both the energy consumption as measured according to section 3.2 of this Appendix and the data specified in section 7 of ANS B149.1-1972.

4. CALCULATION OF DERIVED RESULTS FROM TEST MEASUREMENTS

4.1 Rated Capacity. Calculate the rated capacity, C_r, expressed in pints of condensate collected per 24 hours, in accordance with section 7.5 of ANS B149.1-1972, the resulting quotient then being rounded off to the nearest 0.1 pints/day.

4.2 Hourly Energy Consumption. Calculate the hourly energy consumption (E_h), expressed in kWh per hour and defined as:

$$E_h = C_r/24 \times E_f$$

C_r = the rated capacity as calculated in section 4.1 of this Appendix

E_f = the energy factor as calculated in section 430.22(1)(3).

5. REGIONAL REPRESENTATIVE AVERAGE-USE CYCLE

Region	State	Average-use cycle (hours per year)
1 New England	Maine, New Hampshire, Vermont, Massachusetts, Connecticut, and Rhode Island.	704
2 Middle Atlantic	New York, New Jersey, and Pennsylvania	1,491
3 South Atlantic	Delaware, Maryland, District of Columbia, Virginia, West Virginia, North Carolina, South Carolina, Georgia, and Florida.	2,103
4 East-north-central	Ohio, Indiana, Illinois, Michigan, and Wisconsin	1,166
5 East-south central	Kentucky, Tennessee, Alabama, and Mississippi	2,343
6 West-south central	Arkansas, Louisiana, Oklahoma, and Texas	2,840
7 West-north central	Minnesota, Iowa, Missouri, North Dakota, South Dakota, and Nebraska.	696
8 Mountain	Arizona, Wyoming, Montana, Idaho, Utah, Colorado, New Mexico, and Nevada.	82
9 Pacific	California, Oregon, Washington, Alaska, and Hawaii	941

(Energy Policy and Conservation Act, Pub. L. 94-163, as amended by Pub. L. 94-384; Federal Energy Administration Act of 1974, Pub. L. 93-275, as amended by Pub. L. 94-385; Department of Energy Organization Act, Pub. L. 95-91; E.O. 11790, 39 FR 23185)

[42 FR 55610, Oct. 18, 1977. Redesignated at 44 FR 37938, June 29, 1979]

Appendix M to Subpart B—Uniform Test Method for Measuring the Energy Consumption of Central Air Conditioners

1. DEFINITIONS

1.1 "Annual performance factor" means the total heating and cooling done by a heat pump in a particular region in one year divided by the total electric power used in one year.

1.2 "ARI" means Air-Conditioning and Refrigeration Institute.

1.3 "ARI Standard 210-79" means the test standard published in 1979 by the ARI and titled "Standard for Unitary Air-Conditioning Equipment".

1.4 "ARI Standard 240-77" means the test standard published in 1977 by the ARI and titled "Standard for Air-Source Unitary Heat Pump Equipment".

1.5 "ARI Standard 320-76" means the test standard published in 1976 by the ARI and titled "Standard for Water-Source Heat Pumps". The single number HSPF energy conservation standard for central air conditioning heat pumps specified in section 325(d)(2) (A) and (B) is based on Region IV and the standardized DHR found in section 6 of this appendix, nearest the capacity measured in the 47 °F test.

1.6 "ASHRAE" means the American Society of Heating, Refrigeration and Air-Conditioning Engineers, Inc.

1.7 "ASHRAE Standard 37-78" means the test standard published by ASHRAE in 1978 and titled "Methods of Testing for Rating Unitary Air-Conditioning and Heat Pump Equipment."

1.8 "Continuously recorded" means a method of recording measurements in intervals no greater than 5 seconds.

1.9 "Cooling load factor (CLF)" means the ratio of the total cooling done in a complete cycle of a specified time period, consisting of an "on" time and "off" time, to the steady-state cooling done over the same period at constant ambient conditions.

1.10 "Cyclic Test" means a test where the indoor and outdoor conditions are held constant, but the unit is manually turned "on" and "off" for specific time periods to simulate part-load operation.

1.11 "Degradation coefficient (C_D)" means the measure of the efficiency loss due to the cycling of the unit.

1.12 "Demand-defrost control system" means a system which is designed to perform the defrost function on the outdoor coil of the heat pump only when a predetermined degradation of performance is measured.

1.13 "Design heating requirement (DHR)" is the amount of heating required to maintain a given indoor temperature at a particular outdoor design temperature.

1.14 "Dry-coil test" means a test conducted at a wet-bulb temperature and a dry-bulb temperature such that moisture will not condense on the evaporator coil of the unit.

1.15 "Heating seasonal performance factor (HSPF)" means the total heating output of a heat pump during its normal annual usage period for heating divided by the total electric power input during the same period.

1.16 "Heating load factor (HLF)" means the ratio of the total heating done in a complete cycle of a specified time period, consisting of an "on" time "off" time, to the steady state heating done over the same period at constant ambient conditions.

1.17 "Latent cooling" means the amount of cooling in Btu's necessary to remove water vapor from the air passing over the indoor coil by condensation during a period of time.

1.18 "Part-load factor (PLF)" means the ratio of the cyclic energy efficiency ratio to the steady-state energy efficiency ratio at identical ambient conditions.

1.19 "Seasonal energy efficiency ratio (SEER)" means the total cooling of a central air conditioner in Btu's during its normal annual usage period for cooling divided by the total electric power input in watt-hours during the same period.

1.20 "Sensible cooling" means the amount of cooling in Btu's performed by a unit over a period of time, excluding latent cooling.

1.21 "Single package unit" means any central air conditioner in which all the major assemblies are enclosed in one cabinet.

1.22 "Split system" means any central air conditioner in which one or more of the major assemblies are separate from the others.

1.23 "Steady-state test" means a test in which all indoor and outdoor conditions are held constant and the unit is in non-changing operating mode.

1.24 "Temperature bin" means a 5° F increment over a dry-bulb temperature range of 65° F through 104° F for the cooling cycle and −25° F through 64° F for the heating cycle.

1.25 "Time-temperature defrost control system" means a system which automatically provides the defrost function at a predetermined time interval whenever the outdoor temperature drops below a level where frosting will occur.

1.26 "Test condition tolerance" means the maximum permissible variation of the average of the test observations from the standard or desired test condition as provided in 6.1.1, 6.2.1, 6.2.2, and 6.2.3 of this Appendix.

1.27 "Test operating tolerance" means he maximum permissible difference be- ween the maximum and the minimum in- trument observation during a test as pro- ided in 6.1.1, 6.2.1, 6.2.2, and 6.2.3 of this ppendix.

1.28 "Wet-coil test" means a test con- ucted at a wet-bulb temperature and a dry- ulb temperature such that moisture will ondense on the test unit evaporator coil.

2. TESTING REQUIRED

2.1 *Testing required for air source cool- g only units.* Two steady state wet coil ests required to be performed, test A and est B. Test A is to be conducted as an out- oor dry bulb temperature of 95° F and test at 82° F. Test C and D are optional tests be conducted when cyclic performance arameters are to be measured in order to etermine the degradation coefficient, C° est C is a steady state dry coil test con- ucted at an outdoor dry bulb temperature 82° F. Test D is a cyclic test also conduct- d at an outdoor dry bulb temperature of ° F. In lieu of conducting tests C and D, n assigned value of 0.25 may be used for he degradation coefficient, C°.

2.1.1 *Testing required for units with ngle speed compressors and single speed ondenser fans.* Test A and test B shall be erformed according to the test procedures utlined in 4.1 of this Appendix. In addition, he cyclic performance shall be evaluated by onducting test C and D according to the re- irements outlined in 4.1 of this Appendix.

2.1.2 *Testing required for units with ngle speed compressors and multiple-speed ondenser fans.* The test requirements for ultiple-speed condenser fan units shall be he same as described in section 2.1.1 for ngle speed condensor fan units.

2.1.3 *Testing required for units with two- eed compressors, two compressors, or cyl- der unloading.* The test requirements for o-speed compressor units, two compressor its, or units with cylinder unloading are he same as described in 2.1.1 of this Appen- x except that test A and test B shall be rformed at each compressor speed or at ch compressor capacity.

2.1.4 *Testing required for units with two- eed compressors, two compressors, or cyl- der unloading capable of varying the sen- ble to total (S/T) capacity ratio.* When a it employing a two-speed compressor, two mpressors, or cylinder unloading provides method of varying the ratio of the sensi- e cooling capacity to the total cooling ca- city, (S/T), the test requirements are the me as for two-speed compressor units as scribed in 2.1.3 of this Appendix.

2.1.5 *Testing required for units with iple-capacity compressors.* (Reserved)

2.1.6 *Testing required for units with vari- ble-speed compressors.* The tests for vari- ble-speed equipment consist of five (5) wet coil tests and two (2) dry coil tests. Two of the wet coil tests, A and B, are conducted at the maximum speed. Two wet coil tests, B_1 and low temperature test, are conducted at the minimum speed. The fifth wet coil test is conducted at an intermediate speed. Dry coil tests, C and D, are conducted at the minimum speed if the coefficient of degradation (C_D) value of 0.25 is not adopted. The test conditions and procedures for the above are outlined in sections 3.1 and 4.1 of this Appendix.

2.1.7 *Testing required for split-type ductless systems.* The tests for split-type ductless systems are determined by the type of compressor installed in the outdoor unit. For the appropriate tests refer to sections 2.1.1, 2.1.2, 2.1.3, 2.1.4, 2.1.5, or 2.1.6 of this Appendix.

2.2 *Testing required for air source heating only units.* Four types of tests are required to be performed: High Temperature, Cyclic, Frost Accumulation, and Low Temperature. In lieu of conducting the Cyclic Test an assigned value of 0.25 may be used for the degradation coefficient, C°.

2.2.1 *Testing required for units with single speed compressors.* Units with single speed compressors shall be subjected respectively to the High Temperature Test at 47° F described in section 3.2.1.1, the Cyclic Test as described in section 3.2.1.2, the Frost Accumulation Test as described in section 3.2.1.3, and the Low Temperature Test as described in section 3.2.1.4.

2.2.2 *Testing required for units with two-speed compressors, two compressors, or cylinder unloading.* With the unit operating: at high compressors speed (two-speed compressor), with both compressors in operation (two-compressors), or at the maximum capacity (cylinder unloading); the following tests are required to be performed on all units; the High Temperature Test at 47° F, the Frost Accumulation Test, and the Low Temperature Test. An additional test (cyclic at 47° F) is required, with the unit operating at the high compressor speed (two-speed compressor), with both compressors in operation (two compressors), or at the maximum capacity (cylinder unloading); if the normal mode of operation requires cycling "on" and "off" of the compressor(s) at high speed or maximum capacity.

With the unit operating: at the low compressor speed (two-speed compressor), with the single compressor which normally operates at low loads (two compressors), or at the low compressor capacity (cylinder unloading); the following tests are required to be performed on all units: the High Temperature Test at 47° F, the High Temperature Test at 62° F, and the Cyclic Test. Additional tests, (Frost Accumulation Test and Low Temperature Test) are required, with the unit operating: on low compressor speed (two-speed compressor), with the single compressor which normally operates at low loads (two compressors) or at the low compressor capacity (cylinder unloading), if the unit's low speed, one compressor or low capacity performance at and below 40° F is needed to calculate its seasonal performance.

2.2.3 *Testing required for units with triple-capacity compressors.* (Reserved)

2.2.4 *Testing required for units with variable-speed compressors.* There are seven basic tests and one optional test for variable-speed units. Three tests (high temperature test, low temperature test, and frost accumulation test) are performed at the maximum speed. Three tests (two high temperature and one cyclic test) are performed with the unit operating at minimum speed. A second frost accumulation test is performed at an intermediate speed. The intermediate speed is the same as in the cooling mode.

In lieu of the maximum speed frost accumulation test, two equations are provided in section 4.2 of this Appendix. In lieu of the cyclic test an assigned value of 0.25 may be used for the coefficient of degradation C_D. The optional test is a nominal capacity test applicable to units which have a heating mode maximum speed greater than the cooling mode maximum speed. The conditions and procedures for the above tests are described in sections 3.2 and 4.2 respectively, of this Appendix.

2.2.5 *Testing required for split-type ductless system.* The type of compressor installed in the outdoor unit determines the testing required, refer to previous sections 2.2.1, 2.2.2, 2.2.3, or 2.2.4. The conditions and procedures will be modified as indicated for the various types as stated in sections 3.2 and 4.2 respectively.

2.3 *Testing required for air source units which provide both heating and cooling.* The requirements for units which provide both heating and cooling shall be the same as the requirements in Section 2.1. and 2.2 of this Appendix.

3. TESTING CONDITIONS

3.1 *Testing conditions for air source cooling only units.* The test room requirement and equipment installation procedures are the same as those specified in sections 11.1 and 11.2 of ASHRAE Standard 37-78. Units designed for both horizontal and vertical installation shall be tested in the orientation in which they are most frequently installed. All tests shall be performed at the normal residential voltage and frequency for which the equipment is designed (either 115 or 230 volts and 60 hertz), the test installation shall be designed such that there will be no air flow through the cooling coil due to natural or forced convection while the indoor fan is "off". This shall be accomplished by installing dampers upstream and downstream of the test unit to block the
period air flow. Values of capacity for
purposes are to be rounded off to the
est 100 Btu/hour for capacities less
20,000 Btu/hour; to the nearest 200
hour for capacities between 20,000
37,999 Btu/hour; and to the nearest
Btu/hour for capacities between 38,000
64,999 Btu/hour.

The following conditions listed in
Standard 210.79 shall apply to all tests
formed in Section 3.1 of this Appendix:

5.1.3.4 Cooling Coil Air Quantity.

5.1.3.6 Requirements for Separated
blies.

3.1.1 *Testing conditions for units*
single speed compressors and
speed condenser fans.

3.1.1.1 *Steady state wet-coil perfor*
tests (Test A and Test B). Test A and
shall be performed with the air entering
indoor side of the unit having a dry-
temperature of 80° F and a wet-bulb
ature of 67° F. The dry-bulb temperature
the air entering the outdoor side of the
shall be 95° F in test A and 82° F in
The temperature of the air surrounding
outdoor side of the unit in each test shall
the same as the outdoor entering air
perature except for units or sections
intended to be installed only indoors,
which case the dry-bulb temperature
rounding that indoor side of the unit
be 80° F. For those units which reject
densate to the condenser, located in the
door side of the unit, the outdoor wet-
temperature surrounding the outdoor
of the unit shall be 75° F in test A and
in test B.

3.1.1.2 *Steady state dry coil perform*
test (Test C) and cyclic dry coil perform
test (Test D). Test C and test D shall be
formed with the air entering the indoor
of the unit having a dry-bulb tempera
of 80° F and a wet-bulb temperature
does not result in formation of conde
on the indoor coil. (It is recommended
an indoor wet-bulb temperature of 57° F
less be used.) The dry-bulb temperature
the air entering the outdoor portion of
unit shall be 82° F. The outdoor portion
the unit shall be subject to the same
tions as the requirements for conduc
test B as stated previously in section 3.1.1
Test C shall be conducted with the unit
erating steadily. Test D shall be conduc
by cycling the unit "on" and "off"
manual or automatic operation of
normal control circuit of the unit. The
shall cycle with the compressor "on" for
minutes and "off" for 24 minutes.
indoor fan shall also cycle "on" and "off"
the duration of the indoor fan "on"
"off" periods being governed by the
matic controls which the manufacturer

ally supplies with the unit. The results of
ests C and D shall be used to calculate a
gradation coefficient, C_D by the proce-
ures outlined in 5.1 of this Appendix.

3.1.2 *Testing conditions for units with*
ingle speed compressors and multiple-speed
ondenser fans. The condenser fan speed to
e used in test A shall be that speed which
ormally occurs at an outdoor dry-bulb tem-
erature of 95° F, and for test B, the fan
peed shall be that which normally occurs
t an outdoor dry-bulb temperature of 82° F.
f elected to be performed, tests C and D
hall be conducted at the same condenser
an speed as in test B.

3.1.3 *Testing conditions for units with*
wo-speed compressors, two compressors, or
ylinder unloading. The condenser fan
peed used in conducting test A at each
ompressor speed shall be that which nor-
ally occurs at an outdoor dry-bulb temper-
ture of 95° F. For test B, the condenser fan
peed at each compressor speed shall be
hat which normally occurs at an outdoor
ry-bulb temperature of 82° F. If elected to
e performed, tests C and D shall be con-
ucted at the low compressor speed with the
ame condenser fan speed as used in test B.
or those two-speed units in which the
ormal mode of operation involves cycling
he compressor "on" and "off" at high
peed, tests C and D shall also be performed
ith the compressor operating at high
peed and at a condenser fan speed that
ormally occurs at test A ambient condi-
ions. Units consisting of two compressors
re subject to the same requirements as
hose units containing two-speed compres-
ors, except that when operated at high
peed, both compressors shall be operating
nd when operating at low speed, only the
ompressor which normally operates at an
utdoor dry-bulb temperature of 82° F shall
e operating.

In lieu of conducting tests C and D, an as-
igned value of 0.25 may be used for the
egradation coefficient, C_D, at each com-
ressor speed. If the assigned degradation
oefficient is used for one compressor speed
t must also be used for the other compres-
or speed.

In the case of units with cylinder unload-
ng, the loaded and the unloaded conditions
orrespond to high and low compressor
peed on two-speed units respectively.

3.1.4 *Testing conditions for units with*
wo-speed compressors, two compressors, or
ylinder unloading capable of varying the
ensible to total (S/T) capacity ratio. The
ode of operation selected for controlling
he S/T ratio in the performance of test A
nd test B at each compressor speed shall be
uch that it does not result in an operating
onfiguration which is not typical of a
ormal residential installation. If elected to
e performed, tests C and D shall be con-
ducted at low compressor speed (single compressor operating) with the same S/T control mode as used in test B when performed at the low compressor speed. Likewise, tests C and D shall also be conducted at high compressor speed (two compressors operating) and with the same S/T control mode as in test A when performed at the high compressor speed.

In the case of units with cylinder unloading, the loaded and unloaded conditions correspond to high and low compressor speed on two-speed units respectively.

3.1.5 *Testing conditions for units with triple-capacity compressors.* (Reserved)

3.1.6 *Additional testing conditions for cooling-only units with variable-speed compressors.* For cooling-only units and air-source heat pumps with varaible-speed compressors, the air flow rate at fan speeds less than the maximum fan speed shall be determined by using the fan law for a fixed resistance system. The air flow rate is given by the ratio of the actual fan speed to the maximum fan speed multiplied by the air flow rate at the maximum fan speed. Minimum static pressure requirements only apply when the fan is running at the maximum speed.

3.1.6.1 *Testing conditions for steady-state wet coil tests.* Tests A and B shall be performed at the maximum speed at conditions specified in section 3.1.1 of this Appendix. Test B_1 and the low temperature test are performed at the minimum speed with outdoor dry bulb temperatures of 82°F and 67°F respectively. The intermediate speed wet coil test is performed at the outdoor dry bulb temperature of 87°F. For units which reject condensate the outdoor wet bulb temperature shall be maintained at 75°F for Test A, 65°F for Tests B and B_1, 53.5°F for the low temperature test and 69°F for the intermediate test. The indoor conditions for all wet coil tests are the same as those given in section 3.1.1 of this Appendix.

3.1.6.2 *Test conditions for dry coil tests.* Dry coil Tests C and D are conducted at an outdoor dry bulb temperature of 67°F. For units which reject condensate the outdoor wet bulb temperature shall be maintained at 53.5°F. The indoor dry bulb temperature shall be 80°F and the wet bulb temperature shall be sufficiently low so no condensation occurs on the evaporator (It is recommended that an indoor wet bulb temperature of 57°F or less be used).

3.1.7 *Split-type ductless systems.* Test conditions shall be the same as those specified for the same single outdoor unit compressor type, assuming it was matched with a single indoor coil.

3.1.7.1 *Interconnection.* For split-type ductless systems, all standard rating tests shall be performed with a minimum length of 25 feet of interconnecting tubing between each indoor fan-coil unit and the common outdoor unit. Such equipment in which the interconnection tubing is furnished as an integral part of the machine not recommended for cutting to length shall be tested with complete length of tubing furnished, or with 25 feet of tubing, whichever is greater. At least 10 feet of the interconnection tubing shall be exposed to the outside conditions. The line sizes, insulation and details of installation shall be in accordance with the manufacturer's published recommendation.

3.1.7.2 *Control testing conditions for split-type ductless systems.* For split-type ductless systems, a single control circuit shall be substituted for any multiple thermostats in order to maintain a uniform cycling rate during test D and the high temperature heating cyclic test. During the steady-state tests, all thermostats shall be shunted resulting in all indoor fan-coil units being in operation.

3.1.7.3 *Split-type ductless systems with multiple coils or multiple discharge outlets shall have short plenums attached to each outlet.* Each plenum shall discharge into a single common duct section, the duct section in turn discharging into the air measuring device (or a suitable dampering device when direct air measurement is not employed). Each plenum shall have an adjustable restrictor located in the plane where the plenums enter the common duct section for the purpose of equalizing the static pressures in each plenum. The length of the plenum is a minimum of $2.5\times(A\times B)^{.5}$, A=width and B=height of duct or outlet. Static pressure readings are taken at a distance of $2\times(A\times B)^{.5}$ from the outlet.

3.2 *Testing conditions for air source heating only units.* The equipment under test shall be installed according to the requirements of Section 11.2 of ASHRAE Standard 37–78 and Section 5.1.4.5 of ARI Standard 240–77. Test chamber requirements are the same as given in Section 11.1 of ASHRAE Standard 37–78. Units designed for both horizontal and vertical installation shall be tested in the orientation in which they are most often installed. All tests shall be performed at the normal residential voltage and frequency for which the equipment is designed (either 115 or 230 volts and 60 hertz). Values of capacity for rating purposes are to be rounded off to the nearest 100 Btu/hour for capacities less than 20,000 Btu/hour; to the nearest 200 Btu/hour for capacities between 20,000 and 37,999 Btu/hour; and to the nearest 500 Btu/hour for capacities between 38,000 and 64,999 Btu/hour.

3.2.1 *Testing conditions for units with single speed compressors.*

3.2.1.1 *High temperature test conditions.* The High Temperature Test at 47° F shall be conducted at an outdoor dry-bulb temperature of 47° F and an outdoor wet-bulb
temperature at 43° F. The High T
ture Test at 62° F shall be conducted
outdoor dry-bulb temperature of 62° F
an outdoor wet-bulb temperature of
For both tests, the dry-bulb air temper
entering and surrounding the indoor
tion of the unit shall be 70° F and a
mum wet-bulb temperature of 60° F. The
ration of the tests shall be for a mini
of ½ hour.

3.2.1.2 *Cycling test conditions.* The
cling Test at 47° F shall be conducted a
same dry-bulb and wet-bulb temperatur
the High Temperature Test at 47° F as
scribed in 3.2.1.1. During the Cycling T
the indoor fan shall cycle "on" and "off",
the compressor cycles "on" and "
except that the indoor fan cycling
may be delayed due to controls that are
mally installed with the unit. The com
sor cycling times shall be 6 minutes "
and 24 minutes "off." The test install
shall be designed such that there will b
airflow through the indoor unit due to
ral or forced convection while the
fan is "off." This shall be accomplished
installing dampers upstream and d
stream of the test unit to block the
period airflow.

3.2.1.3 *Frost accumulation test co*
tions. The dry-bulb temperature and the
sultant dew-point temperature of the air
tering the outdoor portion of the unit sh
be 35° F and 30° F respectively. The in
dry-bulb temperature shall be 70° F and
maximum indoor wet-bulb temper
shall be 60° F. The Frost Accumulation T
requires that the unit undergo a def
prior to the actual test. The test then be
at defrost termination and ends at the
defrost termination. Defrost termin
occurs when the controls normally inst
within the unit are actuated to cause
change defrost operation to normal he
operation. During the test, auxiliary r
ance heaters shall not be employed d
either the heating or defrost portion of
test.

3.2.1.4 *Low temperature test condi*
The Low Temperature Test shall be
ducted at a dry-bulb temperature ente
the outdoor portion of the unit of 17° F
a wet-bulb temperature of 15° F. The air
tering the indoor portion of the unit sh
have a dry-bulb temperature of 70° F a
maximum wet-bulb temperature of 60° F.

3.2.1.5 *Additional testing conditions.*
tests shall be conducted at the indoor
air quantities specified in Sections
and 5.1.4.6 and Table 2 of ARI Stan
240–77. The following conditions liste
ARI Standard 240–77 shall apply to all
performed in Section 3.2 of this Appen

3.2.3 *Testing conditions for units*
triple-capacity compressors. (Reserved)

3.2.4 *Testing conditions for units with variable-speed compressors.* The testing condition for variable-speed compressors shall be the same as those for single speed units as described in section 3.2.1 of this Appendix with the following exceptions; the cyclic test is performed with an outdoor dry bulb temperature of 62°F and a wet bulb temperature of 56.5°F. The optional, nominal capacity test shall be performed at the conditions specified for the 47°F high temperature test.

3.2.5 *Testing conditions for split-type ductless system.* The testing conditions for split-type ductless systems shall be based on the type of compressor installed in the single outdoor unit. The heating mode shall have the same piping and control requirements as in 3.1.7.

5.4.4.4 Outdoor-Side Air Quantity; and
5.1.4.5 Requirements for Separated Assemblies.

In all tests, the specified dry-bulb temperature entering the outdoor portion of the unit also applies to the air temperature surrounding the outdoor portion of the unit. Similarly, models where portions are intended to be installed indoors shall have the air temperature surrounding that portion of the unit the same as the indoor air temperature.

3.2.2 *Testing conditions for units with two-speed compressors, two compressors or cylinder unloading.* The testing conditions for two-speed compressors, two compressors, or cylinder unloading shall be the same as those for single speed units as described in 3.2.1.

3.3 *Testing conditions for air source units which provide both heating and cooling.* The testing conditions for units which provide both heating and cooling shall be the same as the requirements in Sections 3.1 and 3.2 of this Appendix.

4.0 *Testing procedures.* Measure all electrical inputs as described in the procedures below. All electrical measurements during all "on" and "off" periods shall include auxiliary power or energy (controls, transformers, crankcase heaters, etc.) delivered to the unit.

4.1 *Test procedures for air source cooling-only units.* All steady-state wet- and dry-coil performance tests on single package units shall simultaneously employ the Air-Enthalpy Method (Section 3 of ASHRAE Standard 37-78) on the indoor side and one other method consisting of either the Air-Enthalpy Method or the Compressor Calibration Method (Section 4 of ASHRAE Standard 37-78 on the outdoor side. All steady-state wet- and dry-coil performance tests on split systems shall simultaneously employ the Air-Enthalpy Method or the Compressor Calibration Method on the indoor side and the Air-Enthalpy Method, the Compressor Calibration Method or the Volatile Refrigerant Flow Method (Section 5 of ASHRAE Standard 37-78) on the outside. All cyclic dry-coil performance tests shall employ the Air-Enthalpy Method, indoor side only. The values calculated from the two test methods must agree within 6 percent in order to constitute a valid test. Only the results from the Air-Enthalpy Method on the indoor side shall be used in the calculations in Section 5.1. Units shall be installed and tested in such a manner that when operated under steady-state conditions, the cooling coil and condenser coil air flows meet the requirements of Sections 5.1.3.4, 5.1.3.5, and 5.1.3.7 of ARI Standard 210.79.

4.1.1 *Test operating procedures.*

4.1.1.1 *Steady-state wet-coil performance tests (Test A and Test B).* Steady-state wet-coil performance tests (A and B) shall be conducted in accordance with the conditions described in sections 3.1.1.1, 3.1.2, 3.1.3, 3.1.4, and 3.1.5 of this Appendix and the procedures described for cooling tests in Section 11.3 of ASHRAE standard 37-78 and evaluated in accordance with the cooling-related requirements of Section 12 of the ASHRAE Standard 37-78. The test room reconditioning apparatus and the equipment under test shall be operated until equilibrium conditions are attained.

4.1.1.2 *Steady-state and cyclic dry-coil performance tests (Test C and Test D).* The steady-state and cyclic dry-coil tests (C and D) shall be conducted as described below in accordance with the conditions described in sections 3.1.1.2, 3.1.2, 3.1.3, 3.1.4, and 3.1.5 of this Appendix. The results shall be evaluated in accordance with the cooling related requirements of Sections 12.1.5, 12.1.6, 12.1.7, of ASHRAE Standard 37.78. The test room reconditioning apparatus and the equipment under test shall be operated until equilibrium conditions are attained, but not for less than one hour before data for test C are recorded. For all equipment test methods including the Compressor Calibration Method, test C shall be performed with data recorded at 10-minute intervals until four consecutive sets of readings are attained with the tolerance prescribed in Section 11.6 of ASHRAE Standard 37-78. When the Air-Enthalpy Method is used on the outdoor side for test C, the requirements of this section shall apply to both the preliminary test and the regular equipment test; the requirements of Section 3.6 of ASHRAE Standard 37-78 shall also apply. Immediately after test C is completed the test unit shall be manually cycled "off" and "on" using the time periods from 3.1.1 of this Appendix until steadily repeating ambient conditions are again achieved in both the indoor and outdoor test chambers, but for not less than 2 complete "off"/"on" cycles. Without a break in the cycling pattern, the unit shall be run through an additional "off"/"on" cycle during which the test data required in 5.1 shall be recorded. During this last cycle, which is referred to as the test cycle, the indoor and outdoor test room ambient conditions shall remain within the tolerances specified in 4.1.3 of this Appendix during the cyclic dry-coil tests, all air moving equipment on the condenser side shall cycle "on" and "off" when the compressor cycles "on" and "off". The indoor air moving equipment shall also cycle "off" as governed by any automatic controls normally installed with the unit. This last requirement applies to units having an indoor fan time delay. Units not supplied with an indoor fan time delay shall have the indoor air moving equipment cycle "on" and "off" as the compressor cycles "on" and "off."

Cooling cyclic tests for variable-speed units shall be conducted by cycling the compressor 12 minutes "on" and 48 minutes "off". The capacity shall be measured for the integration time (θ), which is the compressor "on" time of 12 minutes or the "on" time as extended by fan delay, if so equipped. The electrical energy shall be measured for the total integration time (θ_{tot}) of 60 minutes. In lieu of conducting C and D tests, an assigned value of 0.25 shall be used for the degradation coefficient for cooling, C_D.

4.1.1.3 *Testing procedures for triple-capacity compressors.* (Reserved)

4.1.1.4 *Intermediate cooling steady-state test for units with variable-speed compressors.* For units with variable-speed compressors, an intermediate cooling steady-state test shall be conducted in which the unit shall be operated at a constant, intermediate compressor speed (k=I) in which the dry/bulb and wet-bulb temperatures of the air entering the indoor coil are 80°F_{db} and 67°F_{wb} and the outdoor coil are 87°$_{db}$ and 69°F_{wb}. The tolerances for the dry-bulb and wet-bulb temperatures of the air entering the indoor and outdoor coils shall be the test operating tolerance and test condition tolerance specified in Table 6.1.1 of this Appendix. The intermediate compressor speed shall be the minimum compressor speed plus one-third the difference between the maximum and minimum speeds of the cooling mode. (Inter. speed=min. speed+⅓ (max. speed−min. speed.) A tolerance of plus five percent or the next higher inverter frequency step from that calculated is allowed.

4.1.1.5 *Testing procedures for split-type ductless systems.* Cyclic tests of ductless units will be conducted without dampers. The data cycle shall be preceded by a minimum of two cycles in which the indoor fan cycles on and off with the compressor. For the data cycle the indoor fan will operate three minutes prior to compressor cut-on and remain on for three minutes after compressor cut-off. The integration time for ca-
pacity and power shall be from compres
cut-on time to indoor fan cut-off time. Th
fan power for three minutes after compres
sor cut-off shall be added to the integrat
cooling capacity.

4.1.2 *Test instrumentation.* The stead
state and cyclic performance tests sha
have the same requirements pertaining t
instrumentation and data as those specifie
in Section 10 and Table II of ASHRA
Standard 37.78. For the cyclic dry-coil pe
formance tests, the dry-bulb temperature o
the air entering and leaving the cooling co
or the difference between these two dr
bulb temperatures, shall be continuously r
corded with instrumentation accurate t
within ±0.3° F of indicated value and have
response time of 2.5 seconds or less. Re
sponse time in the time required for the i
strumentation to obtain 63 percent of th
final steady-state temperature differen
when subjected to a step change in tempera
ture difference of 15° F or more. Electric
measurement devices (watt-hour mete
used during all tests shall be accurate t
within ±0.5 percent of indicated value.

4.1.3 *Test tolerances.* All steady-state we
and dry-coil performance tests shall be pe
formed within the applicable operating an
test condition tolerances specified in Sectio
11.6 and Table III of ASHRAE Standard 3
78.

4.1.3.1 The indoor and outdoor avera
dry-bulb temperature for the cyclic dry co
test D shall both be within 1.0° F of th
indoor and outdoor average dry bulb te
perature for the steady-state dry coil test
respectively.

4.1.3.2 The test condition and test ope
ating tolerances for conducting test D a
stated in 6.1.1 of this Appendix. Variation
the test conditions greater than the tole
ances prescribed in 6.1.1 of this Append
shall invalidate the test. It is suggested th
an electric resistance heater having a he
ing capacity approximately equal to th
sum of the cooling capacity and compres
and condenser fan power should be install
in the outdoor test room and cycled "o
and "on" as the unit cycles "on" and "o
respectively to improve control in the o
door test room. Similarly, an electric resi
ance heater having a heating capacity a
proximately equal to the cooling capacity
the unit could be installed in the indoor te
room, and cycled "on" and "off" as the
unit cycles "on" and "off" to improve indo
room control.

4.2 *Testing procedures for air sour
heating only units.*

4.2.1 *Test operating procedures.* All Hi
Temperature Tests, the Cyclic Test, t
Frost Accumulation Test, and the low Te
perature test shall have the performan
evaluated by the Air-Enthalpy Method

the indoor side. In addition, the High Temperature Test and the Low Temperature Test shall have a simultaneous test method (as described in 4.1) used as a check. The values calculated from the two methods must agree within 6 percent in order to constitute a valid test. Only the results from the Air-Enthalpy Method on the indoor side shall be used in the calulations in section 5.2.

4.2.1.1 *Test procedure for high temperature test.* When the outdoor Air-Enthalpy Method is used, the outdoor chamber must not interfere with the normal air circulating pattern during the preliminary test. It is necessary to determine and adjust for system resistance when the outdoor air measuring apparatus is attached to the outdoor portion of the unit. The test room apparatus and test units must be operated for at least one hour with at least ½ hour at equilibrium and at the specified test conditions prior to starting the test. The High Temperature Test shall then be conducted for a minimum of ½ hour with intermittent data being recorded at 10-minute intervals. For all units, especially those having controls which periodically cause the unit to operate in defrost mode, attention should be given to prevent defrost during the High Temperature Test. Units which have undergone a defrost should operate in the heating mode for at least 10-minutes after defrost termination prior to the start of the test. When the outdoor Air-Enthalpy Method is used as a second test then a preliminary test must be conducted for a minimum of 30 minutes with 4 or more sets of data recorded at 10 minute intervals, all remaining requirements of Section 3.6.1 in the ASHRAE Standard 37–78 shall then apply in conducting the preliminary test for the outdoor air enthalpy method. For some units, at the ambient condition of the test, frost may accumulate on the outdoor coil. If the supply air temperature or the difference between the supply air temperature and the indoor air entering temperature has decreased by more than 1.5° F at the end of the test, the unit shall be defrosted and the test restarted. Only the results of this second High Temperature Test shall be used in the heating seasonal performance calculation in section 5.2. Prior to beginning the High Temperature Test, a unit shall operate in the heating mode for at least 10 minutes after defrost termination to establish equilibrium conditions for the unit and the room reconditioning apparatus. The High Temperature Test may only begin when the test unit and room conditions are within the test condition tolerances specified in Section 6.2.1 of this Appendix.

4.2.1.2 *Test procedures for the cyclic test.* The cyclic test shall follow the High Temperature Test and by cycled "on" and "off" as specified in 3.2.1.2 until steadily repeating ambient conditions are achieved for both the indoor and outdoor test chambers, but for not less than 2 complete "off"/"on" cycles. Without a break in the cycling pattern, the unit shall be operated through an additional "off"/"on" cycle, during which the required test data shall be recorded. During the last cycle, which is referred to as the test cycle, the indoor and outdoor test room ambient conditions shall remain within the tolerance specified in section 6.2.2. of this Appendix. If, prior to the High Temperature Test, the unit underwent a defrost cycle to rid the outdoor coil of any accumulated frost, then prior to cycling the unit "off" and "on" it should be made to undergo a defrost. After defrost is completed and before starting the cycling process, the unit shall be operated continuously in the heating mode for a least 10 minutes to assure that equilibrium conditions have again been established for the unit and the room conditioning apparatus. Cycling the unit may begin when the test unit and room conditions are within the High Temperature Test condition tolerances specified in section 6.2.1 of this Appendix. Attention should be given to prevent defrost after the cycling process has begun.

The cycle times for variable-speed units is the same as the cyclic time in the cooling mode as specified in section 4.1.1.2 of this Appendix. Cyclic tests of split-type ductless units will be conducted without dampers, and the data cycle shall be preceded by a minimum of two cycles in which the indoor fan cycles on and off with the compressor. During the data cycle for the split type ductless units, the indoor fan will operate three minutes prior to compressor "cut-on" and remain on for three minutes after compressor "cut-off". The integration time for capacity and power will be from compressor "cut-on" time to indoor fan "cut-off" time. The fan power for the three minutes after compressor "cut-off" shall be subtracted from the integrated heating capacity. For split-type ductless systems which turn the indoor fan off during defrost, the indoor supply duct shall not be blocked.

4.2.1.3 *Test procedures for the frost accumulation test.* The defrost controls shall be set at the normal settings which most typify those encountered in Region IV as described in section 6.2.4 and 6.2.5 of this Appendix. The test room reconditioning equipment and the unit under test shall be operated for at least ½ hour prior to the start of a "preliminary" test period. The preliminary test period and the test period itself are to be conducted within the test tolerances given in section 4.2.3.3 of this Appendix. In some cases, the preliminary defrost cycle may be manually induced, however, it is important that the normally operating controls govern the defrost termination in all cases. For units containing defrost controls which are likely to cause defrost at intervals less than one hour when the unit is operating at the required test conditions, the preliminary test period shall start at the termination of a defrost cycle which automatically occurs and shall end at the termination of the next automatically occurring defrost cycle. For units containing defrost controls which are likely to cause defrost at intervals exceeding one hour when operating at the required test condition, the preliminary test period consists of "heating-only" preliminary operation for at least one hour, after which a defrost may be manually or automatically induced. The test period then begins at the termination of this defrost cycle and ends at the termination of the next automatically occurring defrost cycle. If the unit has not undergone a defrost after 12 hours, then the tests shall be concluded and the results calculated for this 12 hour period. For units which turn the indoor fan off during defrost the indoor supply duct shall be blocked during all defrost cycles to prevent natural or forced convection through the indoor unit. During defrost, resistance heaters normally installed with the unit shall be prevented from operating.

For units with variable-speed compressors the frost accumulation test at the intermediate speed shall be conducted such that the unit will operate at a constant, intermediate compressor speed (k=i) as determined in section 4.1.1.4 of this Appendix. The following two equations may be used in lieu of the frost accumulation test for variable-speed

$$\text{(a) } Q_{def}^{k=2}(35)=0.90 * [Q_{ss}^{k=2}(17)+(Q_{ss}^{k=2}(47)-Q_{ss}^{k=2}(17))] * (35-17)/(47-17)$$

$$\text{(b) } E_{def}^{k=2}(35)=0.985 * [E_{ss}^{k=2}(17)+(E_{ss}^{k=2}(47)-E_{ss}^{k=2}(17))] * (35-17)/(47-17)$$

4.2.1.4 *Test procedures for the low temperature test.* Where applicable, the High Temperature Test preparation and performance requirements shall also be used in the Low Temperature Test. The test room reconditioning equipment shall first be operated in a steady-state manner for at least one-half hour at equilibrium and at the specified test conditions. The unit shall then undergo a defrost, either automatic or manually induced. It is important that the unit terminate the defrost sequence by the action of its own defrost controls. The defrost controls are to remain at the same setting as specified in 4.2.1.3. At a time no earlier than 10 minutes after defrost termination, the test shall start. Test duration is one-half hour. For all units, defrost should be prevented during the one-half hour test period.

4.2.2 *Test instrumentation.*

4.2.2.1 *Test instrumentation for the high temperature test.* The indoor air flow rate shall be determined as described in Section 7.1 through 7.4 of ASHRAE Standard 37-78. This requires the construction of an air receiving chamber and discharge chamber separated by partition in which one or more nozzles are located. The receiving chamber is connected to the indoor air discharge side of the test specimen through a short plenum. The exhaust side of the air flow rate measuring device contains an exhaust fan with some means to vary its capacity to obtain the desired external resistance to air flow rate. The exhaust side is then left open to the test room or is ducted through a conditioning apparatus and then back to the test specimen inlet. The static pressure across the nozzles, the velocity pressure, and the static pressure measurements at the nozzle throat shall be measured with manometers which will result in errors which are no greater than ±1.0 percent of indicated value and having minimum scale division not exceeding 2.0 percent of the reading. Static pressure and temperature measurements must be taken at the nozzle throat in order to obtain density of the air. The area of the nozzles shall be determined by measuring their diameter with an error no greater than ±0.2 percent in four places approximately 45 degrees apart around the nozzle in each of two places through the nozzle throat, one at the outlets and the other in the straight section near the radius. The energy usage of the compressor, indoor and outdoor fan, and all other equipment components shall be measured with a watt-hour meter which is accurate to within ±0.5 percent of the quantity measured. Measurements of the air temperature entering and leaving the indoor coil or the difference between these two shall be made in accordance with the requirements of ASHRAE

Standard 41 part 1. These temperatures shall be continuously recorded with instrumentation having a total system accuracy within ±0.3° F of indicated value and a response time of 2.5 seconds or less. Temperature measurements are to be made upstream of the static pressure tap on the inlet and downstream of the static pressure taps on the outlet. The indoor and outdoor dry-bulb temperatures shall be continuously recorded with instrumentation which will result in an error no greater than ±0.3° F of indicated value. The outdoor wet-bulb temperature shall be continuously recorded. Static pressure measurements in the ducts and across the unit shall be made in accordance with Section 8 of ASHRAE Standard 37-78 using equipment which will result in an error no greater than ±0.01 inch of water. Static pressure measurements shall be made and recorded at 5 minute intervals. All other data not continuously recorded shall be recorded at 10 minute intervals.

4.2.2.2 *Test instrumentation for the cycling test.* The air flow rate during the on-period of the Cyclic Test shall be the same agreed within ±1. percent as the air flow rate measured during the previously conducted High Temperature Test. All other instrumentation requirements are identical to 4.2.2.1 of this Appendix.

4.2.2.3 *Test instrumentation for the frost accumulation test.* The air flow rate for the Frost Accumulation Test shall be the same as described in 4.2.2.1. The indoor-side dry-bulb temperature and outdoor-side dry-bulb temperature shall be continuously recorded with instrumentation having a total system accuracy within ±0.3° F of indicated value. The outdoor dew point temperature shall be determined with an error no greater than ±0.5° F of indicated value using continuously recording instrumentation. All other data shall be recorded at 10 minute intervals during the heating cycle. Defrost initiation, termination and complete test cycle time (from defrost termination to defrost termination) shall be recorded. Defrost initiation is defined as the actuation (either automatically or manually) of the controls normally installed with the unit which cause it to alter its normal heating operation in order to eliminate possible accumulations of frost on the outdoor coil. Defrost termination occurs when the controls normally within the unit are actuated to change from defrost operation to normal heating operation. Provisions should be made so that instrumentation in capable of recording the cooling done during defrost as well as the total electrical energy usage during defrost. These data and the continuously recorded data need be the only data obtained during defrost.

4.2.2.4 *Test instrumentation for the low temperature test.* Instrumentation for the Low Temperature Test is identical to that of the High Temperature Test described in section 4.2.2.1 of this Appendix.

4.2.3 *Test tolerances.*

4.2.3.1 *Test tolerances for the high temperature test.* All tests shall be conducted within the tolerances specified in Section 6.2.1. Variation greater than those given shall invalidate the test. The heating capacity results by the indoor Air Enthalpy Method shall agree within 6 percent of the value determined by any other simultaneously conducted capacity test in order for the test to be valid.

4.2.3.2 *Test tolerances for the cyclic test.* The test condition tolerances and test operating tolerances for the on-period portion of the test cycle are specified in Section 6.2.2. Variation exceeding any specified test tolerance shall invalidate the test results.

4.2.3.3 *Test tolerances for the frost accumulation test.* Test condition and test operating tolerances for Frost Accumulation Tests are specified in Section 6.2.3. Test operating tolerances during heating applies when the unit is in the heating mode, except for the first 5 minutes after the termination of a defrost cycle. Test operating tolerance during defrost applies during a defrost cycle and during the first 5 minutes after defrost termination when the unit is operating in the heating mode. In determining whether the test condition tolerances are met, only the heating portion of the test period shall be used in calculating the average values. Variations exceeding the tolerances presented in Section 6.2.3 shall invalidate the test.

4.2.3.4 *Test tolerances for the low temperature test.* During the test period for the Low Temperature Test, the operating conditions shall be within the tolerances specified in Section 6.2.1 of this Appendix.

4.3 *Testing procedures for air source units which provide both heating and cooling.* The testing procedures for units which provide both heating and cooling shall be the same as those specified in Sections 4.1 and 4.2 of this Appendix. Also during the off-period of the dry-coil cooling test (test D), the switch-over valve shall remain in the cooling mode, unless the controls normally supplied with the unit are designed to reverse it, in which case the controls shall operate the valve. During the off-period of the cyclic heating test at 47° F, the switch-over valve shall remain in the heating mode, unless the controls normally supplied with the unit are designed to reverse it, in which case the controls shall operate the valve.

5.0 *Calculations for performance factors.*

5.1 *Calculations of seasonal energy efficiency ratios (SEER) in air-source units.*

The testing data and results required to calculate the seasonal energy efficiency ratio (SEER) in Btu's per watt-hour shall include the following:

(i) Cooling capacities (Btu/hr) from tests A and B and, if applicable, the cooling capacity (Btu/hr) from test C and the total cooling done from test D (Btu's).

Q_{ss}^{k} (95F)
Q_{ss}^{k} (82F)
Q_{ss} dry
Q_{cyc} dry

(ii) Electrical power input to all components and controls (watts) from tests A, B, and if applicable the electrical power input to all components and controls (watts) from test C and the electrical usage (watt-hour) from test D.

E_{ss}^{k} (95F)
E_{ss}^{k} (82F)
E_{ss}^{k}, dry
E_{cyc} dry

(iii) Indoor air flow rate (SCFM) and external resistance to indoor air flow (inches of water).

(iv) Air temperature (° F)

Outdoor dry bulb
Outdoor wet bulb
Indoor dry bulb
Indoor wet bulb

Where the cooling capacities Q_{ss}^{k} (95F), from test A, Q_{ss}^{k} (82), from test B, and Q_{ss} dry, from test C, are calculated using the equations specified in section 3.7 of ASHRAE Standard 37-78. The total cooling done, Q_{cyc} dry from test D, is calculated using equation (1) below.

Units which do not have indoor air circulating fans furnished as part of the model shall have their measured total cooling capacities adjusted by subtracting 1250 Btu/hr per 1,000 CFM of measured indoor air flow and adding to the total steady-state electrical power input 365 watts per 1,000 CFM of measured indoor air flow.

Energy efficiency ratios from tests A, B and C, EER_{A}, EER_{B}, EER_{C} dry respectively, are each calculated as the ratio of the total cooling capacity in Btu/hr to the total electrical power input in watts.

Units which do not have indoor air circulating fans furnished as part of the model shall adjust their total cooling done and energy used in one complete cycle for the effect of circulating indoor air equipment power. The value to be used for the circulating indoor air equipment power shall be 1250 Btu/hr per 1,000 CFM of circulating indoor air. The energy usage required in one complete cycle required for indoor air circulation is the product of the circulating indoor air equipment power and the duration of time in one cycle that the circulating indoor air equipment is on. The total cooling done shall then be the measured cooling in one complete cycle minus the energy usage required for indoor air circulation in one complete cycle. The total electrical energy usage shall be the sum of the energy usage required for indoor air circulation in one complete cycle and the energy used by the remaining equipment components (compressor(s), outdoor fan, crankcase heater, transformer(s), etc.) in one complete test cycle.

Energy efficiency ratio from tests D, EER_{cyc} dry is calculated as the ratio of the total cooling done in Btu's to the total electrical energy usage in watt-hours.

The results of the cyclic and steady-state dry-coil performance tests shall be used in the following (4) equations:

$$(1)\qquad Q_{cyc,\,dry}=\frac{60\times \dot{V}\times C_{pa}\times \Gamma}{[V_n'\times(1+W_n)]}$$

where

$Q_{cyc,\,dry}$ = Total cooling over a cycle consisting of one compressor "off" period and one compressor "on" period (Btu's).

$\dot{V}$ = Indoor air flow rate (cfm) at the dry-bulb temperature, humidity ratio, and pressure existing in the region of measurement.

C_{pa} = Specific heat at constant pressure of air-water mixture per pound of dry air, (Btu/lb-°F).

V_n' = Specific volume of air-water mixture at the same dry-bulb temperature, humidity ratio, and pressure used in the determination of the indoor air flow rate (ft³/lb).

W_n = Humidity ratio (lb/lb).

and Γ (hr.-°F), which is described by the equation:

$$(2)\qquad \Gamma=\int_{\text{(time indoor fan on)}}^{\text{(time indoor fan off)}}[T_{a1}(t)-T_{a2}(t)]\,dt$$

where

$T_{a1}(t)$ = Dry bulb temperature of air entering the indoor coil (°F) at time (t).

$T_{a2}(t)$ = Dry-bulb temperature of air leaving the indoor coil (°F) at time (t).

$$(3)\qquad CLF=\frac{Q_{cyc,\,dry}}{Q_{ss\,dry}\times\tau}$$

where

CLF = cooling load factor.

$Q_{ss\,dry}$ = Total steady-state cooling capacity from test C (Btu/hr).

τ = Duration of time (hours) for one complete cycle consisting of one compressor "on" time and one compressor "off" time.

The preceding equations are then used in the following equation to calculate a degradation coefficient C_D rounded to the nearest .01.

$$(4)\qquad C_D=\frac{1-\dfrac{EER_{cyc,\,dry}}{EER_{ss,\,dry}}}{1-CLF}$$

where

$EER_{ss,\,dry}$ = Energy efficiency ratio from test C, (Btu/watt-hr).

5.1.1 Method for calculating a SEER for units with single-speed compressor and single-speed condenser fans. The seasonal energy efficiency ratio for units employing single-speed compressors and single-speed condenser fans shall be based on the performance of test B and a method outlined in 2.1.1 and 3.1.1 of this Appendix to account for the cyclic performance.

The seasonal energy efficiency ratio in Btu's/watt-hour shall be determined by the equation:

$$SEER=PLF(0.5)\times EER_B$$

where

EER_B = Energy efficiency ratio determined from test B as outlined in 2.1.1.

$PLF(0.5)$ = Part-load performance factor when cooling load factor = 0.5 as determined from the equation:

$$PLF(0.5)=1-0.5\times C_D$$

where

C_D = Is the degradation coefficient described in 2.1.1 or as calculated in equation (4) above.

5.1.2 Method for calculating a SEER for units with single-speed compressors and multi-speed condenser fans. The seasonal energy efficiency ratio (SEER) for units employing single-speed compressors and multi-speed condenser fans shall be based on the energy efficiency ratio obtained for test B and the method outlined in 2.1.2 of this Appendix to account for the performance under cyclic conditions. The energy efficiency ratio for test B is obtained with the unit operating with the condenser fan speed which normally occurs at test B ambient conditions.

The seasonal energy efficiency ratio in Btu's/watt-hour shall be determined by the equation:

$$SEER=PLF(0.5)\times EER_B$$

where

EER_B = energy efficiency ratio determined from test B in 2.8

$PLF(0.5)$ = Part-load performance factor as determined from the equation:

$$PLF(0.5)=1-0.5\times C_D$$

where

C_D = The degradation coefficient described in 2.1.2 or as calculated in equation (4) above.

5.1.3 Method for calculating a SEER for units with two speed compressors or two compressors, or cylinder unloading. The calculation procedure described in this section shall be based on the performance of test A and B at each of the compressor speeds for two-speed compressor units, subject to the conditions on condenser fan speed described in 3.1.3.

Units operating with two compressors shall have the SEER calculated in the same manner as two-speed compressor units. The superscripted index $k=1$ (and the term "low-speed") designates the compressor that normally operates at an outdoor dry-bulb temperature of 82° F and $k=2$ (and the term "high speed") denotes operation with both compressors.

In order to evaluate the steady-state capacity $Q_{ss}^{k}(T_j)$, and power input, $E_{ss}^{k}(T_j)$, at temperature T_j for each compressor speed, $k=1$, $k=2$, the results of tests A and B from 5.1 shall be used in the following equation:

$$Q_{ss}^{k}(T_j)=Q_{ss}^{k}(95\text{ F})+\frac{Q_{ss}^{k}(82\text{ F})-Q_{ss}^{k}(95\text{ F})}{95-82}[33-(5\times j)]$$

where

$Q_{ss}^{k}(95\text{ F})$ = Steady-state capacity measured from test A as outlined in 2.1.2.

$Q_{ss}^{k}(82\text{ F})$ = Steady-state capacity measured from test B as outlined in 2.1.2.

$$E_{ss}^{k}(T_j)=E_{ss}^{k}(95\text{ F})+\frac{E_{ss}^{k}(82\text{ F})-E_{ss}^{k}(95\text{ F})}{95-82}[33-(5\times j)]$$

when

$E_{ss}^{k}(95\text{ F})$ = Electrical power input measured using test A as outlined in 2.1.2.

$E_{ss}^{k}(82\text{ F})$ = Electrical power input measured from using test A as outlined in 2.1.2.

The building cooling load $BL(T_j)$ for the four cases described in section 5.1.3.1 through 5.1.3.4 shall be obtained from the following equation:

$$BL(T_j)=\frac{(5\times j)-3}{95-65}\times\frac{Q_{ss}^{k-2}(95\text{ F})}{1.1}$$

where

$Q_{ss}^{k-2}(95\text{ F})$ = Steady-state capacity measured from test A in 2.9 at the high compressor speed.

The value of the degradation coefficient C_D^{k-1} for low compressor speed cycling and C_D^{k-2} for high speed on/off compressor cycling is determined as described in section 2.1.3, or as calculated above in equation (1).

5.1.3.1 Units operating at low compressor speed ($k=1$) for which the steady-state cooling capacity, $Q_{ss}^{k-1}(T_j)$, is greater than or equal to the building cooling load, $BL(T_j)$, evaluate the following equations:

$$(1)\qquad X^{k-1}=\frac{BL(T_j)}{Q_{ss}^{k-1}(T_j)}.$$

where

X^{k-1} = Load factor.

$BL(T_j)$ = Building cooling load (Btu/hr) at temperature (T_j) from section 5.1.3.

$Q_{ss}^{k-1}(T_j)$ = Steady-state cooling capacity (Btu/hr) at temperatures (T_j) from section 5.1.3.

$$(2)\qquad \frac{Q(T_j)}{N}=X^{k-1}\times Q_{ss}^{k-1}(T_j)\times\frac{n_j}{N}$$

where

$\frac{Q(T_j)}{N}$ = ratio of total cooling (Btu) in bin j to the number of temperature

$\frac{n_j}{N}$ is the fractional number of hours in bin j from 6.1.2.

$$(3)\qquad \frac{E(T_j)}{N}=\frac{X^{k-1}\times E_{ss}^{k-1}(T_j)}{PLF^{k-1}}\times\frac{n_j}{N}$$

where

$\frac{E(T_j)}{N}$ = ratio of Energy usage (watt-hr.) in bin j to the number of temperature

$$PLF^{k-1}=1-C_D^{k-1}(1-X^{k-1}).$$

Where C_D the degradation described in section 2.1.3 or as above in equation (1).

5.1.3.2 When a unit must alternate tween high ($k=2$) and low ($k=1$) sor speeds to satisfy the building load at a temperature T_j, evaluate following equations:

$$(1)\qquad X^{k-1}=\frac{Q_{ss}^{k-2}(T_j)-BL(T_j)}{Q_{ss}^{k-2}(T_j)-Q_{ss}^{k-1}(T_j)}$$

$$(2)\qquad X^{k-2}=1-X^{k-1}$$

$$(3)\qquad \frac{Q(T_j)}{N}=[X^{k-1}\times Q_{ss}^{k-1}(T_j)+X^{k-2}\times Q_{ss}^{k-2}(T_j)]$$

$$(4)\qquad \frac{E(T_j)}{N}=[X^{k-1}\times E_{ss}^{k-1}(T_j)+X^{k-2}\times E_{ss}^{k-2}(T_j)]$$

5.1.3.3 When a unit must cycle off at high compressor speed order to satisfy the building cooling at a temperature T_j, evaluate the tions provided in section 5.1.3.1 ($k=1$) data with the ($k=2$) data.

5.1.3.4 When a unit operates at high compressor speed ($k=2$) at door temperature T_j evaluate the equations:

$$(1)\qquad \frac{Q(T_j)}{N}=Q_{ss}^{k-2}(T_j)\times\frac{n_j}{N}$$

$$(2)\qquad \frac{E(T_j)}{N}=E_{ss}^{k-2}(T_j)\times\frac{n_j}{N}$$

5.1.3.5 Calculate the SEER in watt-hr. using the values for the terms

$$\frac{Q(T_j)}{N}$$

and

$$\frac{E(T_j)}{N}$$

as determined at each temperature bin according to the applicable conditions described in sections 5.1.3.1 through 5.1.3.4 as follows:

$$SEER=\frac{\sum_{j=1}^{8}\frac{Q(T_j)}{N}}{\sum_{j=1}^{8}\frac{E(T_j)}{N}}$$

5.1.4 Method for calculating a SEER for units with two speed compressor, two compressor or cylinder unloading capable of varying the sensible to total capacity (S/T) ratio. Multi-speed compressor and two-speed compressor units capable of varying the sensible to total capacity ratio (S/T) shall have the seasonal energy efficiency ratio determined as described in section 5.1.3. For such units, the mode of operation selected to determine the steady-state capacities $Q_{ss}^{k}(95)$, $Q_{ss}^{k}(82)$, $E_{ss}^{k}(95)$, $E_{ss}^{k}(82)$, and power inputs at each compressor speed $k=1$, $k=2$, for tests A and B is outlined in section 2.10.

5.1.5 *Seasonal energy efficiency ratio for air-source units with triple-capacity compressors.* (Reserved)

5.1.6 *Seasonal energy efficiency ratio for air-source units with variable-speed compressors.* For air-source units with variable-speed compressors, the seasonal energy efficiency ratio (SEER), shall be defined as follows:

$$SEER=\frac{\sum_{j=1}^{8}\frac{Q(T_j)}{N}}{\sum_{j=1}^{8}\frac{E(T_j)}{N}}$$

where the number of hours in the j^{th} temperature bin $(\frac{n_j}{N})$ is defined in Table 6.1.2 of this Appendix.

The SEER shall be determined by evaluating three cases of the compressor operation. Case I is the same as specified in 5.1.3.1 with the exception that the quantities $Q_{ss}^{k=1}(T_j)$ and $E_{ss}^{k=1}(T_j)$ shall be calculated by the following equations:

$$Q_{ss}^{k=1}(T_j)=Q_{ss}^{k=1}(82°F)+\frac{Q_{ss}^{k=1}(67°F)-Q_{ss}^{k=1}(82°F)}{82-67}\ \bullet (82-T_j)$$

$$E_{ss}^{k=1}(T_j)=E_{ss}^{k=1}(82°F)+\frac{E_{ss}^{k=1}(67°F)-E_{ss}^{k=1}(82°F)}{82-67}\ \bullet (82-T_j)$$

Case II is when the compressor operates at any intermediate (k=v) speed between the maximum (k=2) and minimum (k=1) speeds to satisfy the building cooling load. Evaluate the following equations:

$$Q_{ss}^{k=v}(T_j)=BL\,(T_j)$$

$$E_{ss}^{k=v}(T_j)=\frac{Q_{ss}^{k=v}(T_j)}{EER_{ss}^{k=v}(T_j)}$$

$$\frac{Q(T_j)}{N}=Q_{ss}^{k=v}(T_j)\ \bullet\ \frac{n_j}{N}$$

$$\frac{E(T_j)}{N}=E_{ss}^{k=v}(T_j)\ \bullet\ \frac{n_j}{N}$$

where

$E_{ss}^{k=v}(T_j)$ = the electrical power input required by the unit to deliver capacity matching the building load at temperature T_j.

$Q_{ss}^{k=v}(T_j)$ = the capacity delivered by the unit matching the building load at temperature T_j.

$EER_{ss}^{k=v}(T_j)$ = the steady-state energy efficiency ratio at temperature T_j and an intermediate speed at which the unit capacity matches the building load.

Before the steady-state intermediate speed energy efficiency ratio, $EER_{ss}^{k=v}(T_j)$, can be calculated, the unit performance has to be evaluated at the compressor speed (k=i) at which the intermediate speed test was conducted. The capacity of the unit at any temperature T_j when the compressor operates at the intermediate speed (k=i) may be determined by:

$$Q_{ss}^{k=i}(T_j)=Q_{ss}^{k=i}(87)+M_Q(T_j-87)$$

where

$Q_{ss}^{k=i}(87)$ = the capacity of the unit at 87°F determined by the intermediate cooling steady-state test.

M_Q=slope of the capacity curve for the intermediate compressor speed (k=i)

$$M_Q=\frac{Q_{ss}^{k=1}(82)-Q_{ss}^{k=1}(67)}{82-67}*(1-N_Q)$$

$$+N_Q*\ \frac{Q_{ss}^{k=2}(95)-Q_{ss}^{k=2}(82)}{95-82}$$

$$N_Q=\frac{Q_{ss}^{k=i}(87)-Q_{ss}^{k=1}(87)}{Q_{ss}^{k=2}(87)-Q_{ss}^{k=1}(87)}$$

Once the equation for $Q_{ss}^{k=i}(T_j)$ has been determined, the temperature where $Q_{ss}^{k=i}(T_j)=BL(T_j)$ can be found. This temperature is designated as (T_{vc}). The electrical power input for the unit operating at the intermediate compressor speed (k=i) and the temperature (T_{vc}) is determined by:

$$E_{ss}^{k=i}(T_{vc})=E_{ss}^{k=i}(87)+M_E\,(T_{vc}-87)$$

where

$E_{ss}^{k=i}(87)$=the electrical power input of the unit at 87°F determined by the intermediate cooling steady-state test

M_E=slope of the electrical power input curve for the intermediate compressor speed (k=i)

$$M_E=\frac{E_{ss}^{k=1}(82)-E_{ss}^{k=1}(67)}{82-67}\ *(1-N_E)$$

$$+N_E\ \ \frac{E_{ss}^{k=2}(95)-E_{ss}^{k=2}(82)}{95-82}$$

$$N_E=\frac{E_{ss}^{k=i}(87)-E_{ss}^{k=1}(87)}{E_{ss}^{k=2}(87)-E_{ss}^{k=1}(87)}$$

The energy efficiency ratio of the unit, $EER_{ss}(T_{vc})$, at the intermediate speed (k=i) and temperature T_{vc} can be calculated by the equation:

$$EER_{ss}^{k=i}(T_{vc})=\ \frac{Q_{ss}^{k=i}(T_{vc})}{E_{ss}^{k=i}(T_{vc})}$$

Similarly, energy efficiency ratios at temperatures T_1 and T_2 can be calculated by the equations:

$$EER_{ss}^{k=1}(T_1)=\ \frac{Q_{ss}^{k=1}(T_1)}{E_{ss}^{k=1}(T_1)}$$

$$EER_{ss}^{k=2}(T_2)=\ \frac{Q_{ss}^{k=2}(T_2)}{E_{ss}^{k=2}(T_2)}$$

where

T_1=temperature at which the uni operating at the minimum com pressor speed, delivers capacit equal to the building loa ($Q_{ss}^{k=1}(T_1)$= $BL(T_1)$), found b equating the capacity equati [($Q_{ss}^{k=1}(T_j)$)] and building loa equation [$BL(T_j)$)] in section 5.1 and solving for temperature.

T_2=temperature at which the uni operating at the maximum com pressor speed, delivers capacit equal to the building loa ($Q_{ss}^{k=2}(T_2)=BL(T_2)$), found b equating the capacity equati [($Q_{ss}^{k=2}(T_j)$)] and the building equa tion [$BL(T_j)$)] in section 5.1.3 an solving for temperature.

$EER_{ss}^{k=1}(T_1)$=the steady state energ efficiency ratio at th minimum compress speed at temperatu T_1.

$EER_{ss}^{k=2}(T_2)$=the steady state energ efficiency ratio at th maximum compress speed at temperatu T_2.

$E_{ss}^{k=1}(T_1)$=the electrical power inpu at the minimum compre sor speed at temperatu T_1, calculated by the equ tion in section 5.1.3.

$E_{ss}^{k=2}(T_2)$=the electrical power inpu at the maximum compre sor speed at temperatu T_2, calculated by the equ tion in section 5.1.3.

The energy efficiency rati $EER_{ss}^{k=v}(T_j)$, shall be calculated by th following equation:

$$EER_{ss}^{k=v}(T_j)=A+B*T_j+C*\ T_j{}^2$$

where coefficients A, B, and C shall b evaluated using the following calcul tion steps:

$$D=\frac{T_2{}^2-T_1{}^2}{T_{vc}{}^2-T_1{}^2}$$

$$B=\frac{EER_{ss}^{k=1}(T_1)-EER_{ss}^{k=2}(T_2)-D(EER_{ss}^{k=1}(T_1)-EER_{ss}^{k=1}(T_{vc}))}{T_1-T_2-D^{*}(T_1-T_{vc})}$$

$$C=\frac{EER_{ss}^{k=1}(T_1)-EER_{ss}^{k=2}(T_2)-B^{*}(T_1-T_2)}{T_1^{2}-T_2^{2}}$$

$$A=EER_{ss}^{k=2}(T_2)-B^{*}T_2-C^{*}T_2^{2}$$

Case III is the same as specified in 5.1.3.4. The quantities $Q_{ss}^{k=1}(T_j)$ and $E_{ss}^{k=1}(T_j)$ and $E_{ss}^{k=2}(T_j)$ shall be calculated by the equations prescribed in 5.1.3.

5.1.7. *Seasonal energy efficiency ratio for split-type ductless systems.* For split-type ductless systems, SEER shall be defined as specified in section 5.1.1 of this Appendix for each combination set of indoor coils to be used with a common outdoor unit.

5.2 *Calculation of Heating Seasonal Performance Factors (HSPF) for Air-Source Units.*

The testing data and results required to calculate the heating seasonal performance factor (HSPF), in Btu's per watt-hr, shall include the following:

(i) Heating capacities (Btu/hr) from the indoor air enthalpy method for the High Temperature Tests, and the total heating done (Btu's) for the cyclic and frost accumulation tests.

$\dot{Q}_{ss}(47)$ or $\dot{Q}_{ss}(62)$.
$\dot{Q}_{ss}(17)$.
$Q_{cyc}(47)$.
$Q_{DEF}(35)$.

(ii) Electrical power input to all components (watts) for the steady state tests, and the electrical usage (watt-hours) for the cyclic and frost accumulation tests

$\dot{E}_{ss}(47)$ or $\dot{E}_{ss}(62)$.
$\dot{E}_{ss}(17)$.
$E_{cyc}(47)$.
$E_{DEF}(35)$.

(iii) Indoor air flow rate (SCFM) and external resistance to indoor air flow (inches of water).

(iv) Air temperature (°F)
Outdoor dry bulb
Outdoor wet bulb or dew point
Indoor dry bulb and
Indoor wet bulb.

(v) Data as specified in Table II of ASHRAE Standard 37-78.

Where the heating capacities $\dot{Q}_{ss}(47)$, $\dot{Q}_{ss}(62)$ and $\dot{Q}_{ss}(17)$ and the indoor air flow rate are calculated using the equations specified in section 3.8.1 and 7.4 of ASHRAE standard 37-78. The total heating done, $Q_{cyc}(47)$ and $Q(_{DEF}35)$ are calculated using the equations below.

Units not having an indoor fan as part of the model tested shall add 1250 Btu/hr per 1,000 SCFM of indoor air handled to the measured capacity to obtain the total heating capacity, $\dot{Q}_{ss}(17)$, $\dot{Q}_{ss}(47)$ or $\dot{Q}_{ss}(62)$, and add 365 watts per 1,000 SCFM of indoor air handled to the measured power to obtain the total power input, $\dot{E}_{ss}(17)$, $\dot{E}_{ss}(47)$, or $\dot{E}_{ss}(62)$, to the unit.

The coefficients of performance (COP) for the High Temperature Tests $COP_{ss}(62)$ or $COP_{ss}(47)$, and Low Temperature Test, $COP_{ss}(17)$, are calculated as the ratio of the heating capacity in Btu/hr to the product of 3.413 and the power inputs to the indoor fan in watts and the power inputs to the remaining equipment components (including all controls) in watts.

Units which do not have indoor air circulating fans furnished as part of the model shall have their total heating done ($Q_{cyc}(47)$) and energy used $E_{cyc}(47)$ in one complete cycle adjusted for the effect of circulating indoor air equipment power. For units tested without an indoor fan as part of the model, $Q_{cyc}(47)$ shall be increased by a quantity of heat equal to the product of 1250 Btu/hr per 1,000 SCFM, the length of the on-period of the test cycle in hours, and the flow rate of indoor air circulated in units of 1,000 SCFM. The total energy usage, $E_{cyc}(47)$, shall be the sum of the energy usage required for air circulation during the test cycle and the energy used by the remaining equipment components (including all controls) during the test cycle. Units not having an indoor fan as part of the model tested, shall set the energy required for indoor air circulation equal to the quantity given by the product of 365 watts per 1000 SCFM, the length of the on-period of the test cycle in hours, and the rate of indoor air circulated in units of 1000 SCFM.

The cyclic coefficient of performance, $COP_{cyc}(47)$ is calculated as the ratio of the total heating done ($Q_{cyc}(47)$) in Btu's to the product of 3.413 Btu/watt-hour and the total energy usage ($E_{cyc}(47)$) in watt hours.

The net heating capacity, $\dot{Q}_{DEF}(35)$ (Btu/hr), is the total net heating done over the test period (including any credit for the indoor fan heat) divided by the total length of the test period, in hours.

For units tested without indoor fans, the value determined for $\dot{Q}_{DEF}(35)$ below shall be increased by a quantity of heat equal to the product of 1250 Btu/hr per 1000 SCFM, the length of time in hours during the Frost Accumulation Test that there was indoor air circulating, and the average flow rate of indoor air circulated in units of 1000 SCFM.

The total energy usage, $E_{DEF}(35)$ shall be the sum of the energy usage required for indoor-air circulation during the test period and the energy used by the remaining equipment components during the test period. Units not having an indoor fan as part of the model tested, shall set the energy required for indoor air circulation equal to the quantity given by the product of 365 watts per 1000 SCFM, the length of time in hours during the Frost Accumulation Test that there was indoor air circulating, and the average flow rate of indoor air circulated in units of 1000 SCFM.

The actual heating done during the Cyclic Test, $Q_{cyc}(47)$, shall be determined using the following equation:

$$(1)\qquad Q_{cyc}(47)=\frac{60\times\dot{V}\times C_{pa}\times\Gamma}{[V_a{}^{1}\times(1+W_a)]}$$

where

$\dot{V}$ = the flow rate during the on-period calculated in accordance with section 7.4 of ASHRAE Standard 37-78 in CFM.

C_{pa} = Specific heat at constant pressure of air-water mixture per pound of dry air, (Btu/lb-°F).

$V_a{}^{1}$ = Specific volume of air-water mixture at the same dry-bulb temperature, humidity ratio, and pressure used in the determination of the indoor air flow rate (ft³/lb).

W_a = Humidity ratio (lb/lb).

and Γ (hr-°F), which is described by the equation:

$$\Gamma=\int_{\text{(time indoor fan on)}}^{\text{(time indoor fan off)}}[T_{a2}(t)-T_{a1}(t)]dt$$

where

$T_{a1}(t)$ = Dry-bulb temperature of air entering the indoor coil (°F) at time (t).

$T_{a2}(t)$ = Dry-bulb temperature of air leaving the indoor coil (°F) at time (t).

The net heating, Q_{DEF} (35) in Btu's done during the test period shall be determined using the following equation:

$$(2)\qquad Q_{DEF}(35)=\frac{60\times\dot{V}\times C_{pa}\times\Gamma}{[V_a{}^{1}\times(1+W_a)]}$$

where

$\dot{V}$ = the average of the air flow rate calculated at t or more time intervals throughout the h phase of the test using the equation in section of ASHRAE Standard 37-78.

C_{pa} = Specific heat at constant pressure of air-wa mixture per pound of dry air, (Btu/lb-°F).

$V_a{}^{1}$ = Specific volume of air-water mixture at the sa dry-bulb temperature, humidity ratio, and pr sure used in the determination of the indoor flow rate (ft³/lb).

W_a = Humidity ratio (lb/lb).

and Γ (hr.-°F), which is described by th equation:

$$\Gamma=\int_{\text{(time of defrost termination}}^{\text{(time of next defrost termination)}}\times[T_{a2}(t)-T_{a1}(t)]$$

where

$T_a{}^{1}(t)$ = Dry-bulb temperature of air entering the in door coil (°F) at time (t).

$T_a{}^{2}(t)$ = Dry-bulb temperature of air leaving the indo coil (°F) at time (t).

The cyclic degradation coefficient sh be calculated as follows:

$$(3)\qquad C_D=\frac{1-\dfrac{COP_{cyc}(47)}{COP_{ss}(47)}}{1-HLF}$$

where

C_D = the cyclic degradation coefficient roun to the nearest .01

$COP_{cyc}(47)$ as defined above

$COP_{ss}(47)$ as defined above

HLF is the heating load factor calculated follows:

$$HLF=\frac{Q_{cyc}(47)}{\dot{Q}_{ss}(47)\times\tau}$$

where

$Q_{cyc}(47)$ as defined above

$\dot{Q}_{ss}(47)$ as defined above

τ = Duration of time (hours) for one com cycle consisting of one compressor "on" ti and one compressor "off" time.

For air-source units that are equipp with "demand defrost control system the value for HSPF, as determin above shall be multiplied by an e hancement factor F_{def} to compens for improved performance not mea ured in the Frost Accumulation Te The factor, F_{def} depends on the numb of defrost cycles in a 12-hour period a should be calculated as follows:

$$F_{def}=1+0.03*(1-(T_{test}-90)/(T_{max}-90))$$

where

F_{def} = demand defrost credit (used as a multiplier to HSPF)

T_{test} = time between defrost terminations in minutes or 90 (whichever is greater)

T_{max} = maximum time between defrosts allowed by controls, in minutes or 720 (whichever is less)

5.2.1 Calculation of the heating seasonal performance factor (HSPF) for air-source heat pumps with single speed compressors.

For each climatic region listed in section 6.2.4, and for design heating requirements equal to both the standardized minimum and maximum design heating requirements defined below, calculate the HSPF defined as:

HSPF

$$=\frac{\sum_j \frac{n_j}{N} BL(T_j)}{\left[\sum_j \frac{n_j}{N} \frac{X(T_j)}{PLF(X)} \delta(T_j)\dot{E}(T_j)(T_j) + \sum_j \frac{RH(T_j)}{N}\right]},$$

where

j = 1,2,3, . . . , n corresponds to the j^{th} temperature bin.

n = total number of non-zero temperature bins in the climatic region.

$T_j = (67-5j)$ is the representative temperature of the j^{th} bin, (°F).

$\sum_j$ = indicated the quantity following the symbol is to be summed over all temperature bins.

$\frac{RH(T_j)}{N}$ = supplementary resistance heat term at temperature T_j required in those cases where the heat pump automatically turns off ($T_j < T_{off}$) or when it is needed to meet the balance of the building heating requirements. (watts).

$\frac{n_j}{N}$ = is the number of hours in the j^{th} temperature bin divided by $N \equiv \sum_j n_j$ and is referred to as the "fractional hours in j^{th} temperature bin".

3.413 = is a conversion factor which converts watt hours to Btu.

$BL(T_j)$ = building load at temperature T_j, (Btu/hr).

$\delta(T_j)$ = heat pump low temperature cut-out factor.

$X(T_j)$ = heat pump heating load factor.

$PLF(X)$ = heat pump part load factor.

The quantities $BLCT_j)$, $\delta(T_j)$, $X(T_j)$, $PLF(X)$ and

$$\frac{RH(T_j)}{N}$$

are defined by the following equations:

$$BL(T_j)=\left(\frac{65-T_j}{65-T_{OD}}\right)(C)(DHR)$$

where

(C) = 0.77 is a correction factor which tends to improve the agreement between calculated and measured building loads

(DHR) = the minimum and maximum design heating requirement which the heat pump is likely to encounter when installed in a residence, rounded off to the nearest standardized DHR in section 6.26 in Btu/hr

where

(minimum design heating requirement)

$$=\begin{cases}\dot{Q}_{ss}(47)\,\frac{(65-T_{OD})}{60}, & \text{for regions I, II, III, IV, and VI}\\ \dot{Q}_{ss}(47), & \text{for region V}\end{cases}$$

and

maximum design heating requirement

$$=\begin{cases}2\dot{Q}_{ss}(47)\,\frac{(65-T_{OD})}{60}, & \text{for regions I, II, III, IV, and VI}\\ 2.2\dot{Q}_{ss}(47), & \text{for region V}\end{cases}$$

where

$\dot{Q}_{ss}$ (47) is the heat pump capacity measured during the High Temperature Test @ 47° F

T_{OD} is the outdoor design temperature given in section 6.2.4

$$\delta(T_j)=\begin{cases}0; \; T_j \le T_{OFF} \text{ or } \frac{\dot{Q}(T_j)}{(3.413)(\dot{E}(T_j))} < 1\\ \frac{1}{2}; \; T_{OFF} < T_j \le T_{ON} \text{ and } \frac{\dot{Q}(T_j)}{(3.413)(\dot{E}(T_j))} \ge 1\\ 1; \; T_j > T_{ON} \text{ and } \frac{\dot{Q}(T_j)}{(3.413)(\dot{E}(T_j))} \ge 1\end{cases}$$

$$X(T_j)=\begin{cases}\frac{BL(T_j)}{\dot{Q}(T_j)}; \; \dot{Q}(T_j) \ge BL(T_j)\\ 1; \; \dot{Q}(T_j) \le BL(T_j)\end{cases}$$

$$PLF(X)=1-C_D(1-X(Tj))$$

$$\frac{RH(T_j)}{N}=\frac{[BL(T_j)-\dot{Q}(T_j)X(T_j)\delta(T_j)]\,\frac{n_j}{N}}{3.413}$$

where

T_{OFF} = the outdoor temperature that the compressor is automatically shut off at (If no such temperature exists, T_j is always greater than T_{OFF} and T_{ON}.)

T_{ON} = the outdoor temperature that the compressor is automatically turned on (if applicable) if designed for low temperature automatic shut-off.

C_D = degradation factor determined described in section 5.2 and 2.2.1.

In using the above equation to calculate HSPF, the heat pump capacity in Btu/hr, $\dot{Q}$, and the power in watts, $\dot{E}$, shall be obtained as follows:

$$\dot{Q}(T_j)=\begin{cases}\dot{Q}_{ss}(17)+\dfrac{(\dot{Q}_{ss}(47)-\dot{Q}_{ss}(17))\times(T_j-17)}{30}, & T_j\geq 45^{\circ}\mathrm{F} \text{ or } T_j\leq 17^{\circ}\mathrm{F}\\ \dot{Q}_{ss}(17)+\dfrac{(\dot{Q}_{DEF}(35)-\dot{Q}_{ss}(17))\times(T_j-17)}{18}, & 17^{\circ}\mathrm{F}<T_j<45^{\circ}\mathrm{F}\end{cases}$$

$$\dot{E}(T_j)=\begin{cases}\dot{E}_{ss}(17)+\dfrac{(\dot{E}_{ss}(47)-\dot{E}_{ss}(17))\times(T_j-17)}{30}, & T_j\geq 45^{\circ}\mathrm{F} \text{ or } T_j\leq 17^{\circ}\mathrm{F}\\ \dot{E}_{ss}(17)+\dfrac{(\dot{E}_{DEF}(35)-\dot{E}_{ss}(17))\times(T_j-17)}{18}, & 17^{\circ}\mathrm{F}<T_j<45^{\circ}\mathrm{F}\end{cases}$$

where $\dot{Q}_{ss}(47)$ and $\dot{E}_{ss}(47)$ and $\dot{Q}_{DEF}(35)$ and $\dot{E}_{ss}(47)$ and $\dot{Q}_{ss}(17)$ and $\dot{E}_{ss}(17)$ are the capacities (in Btu/hr) and powers (in watts), measured during the High Temperature Test, the Frost Accumulation test, and the Low Temperature Test, respectively.

Once the maximum and minimum HSPF and operating cost values have been obtained for each region, the HSPF and operating cost shall be determined for each standardized design heating requirement (see section 6.2.6) between the maximum and minimum design heating requirements by means of interpolation.

5.2.2 Calculation of the heating seasonal performance factor (HSPF) for air source heat pumps with a two-speed compressor, two compressors, or cylinder unloading.

For each climatic region listed in sectio 6.2.4, and for design heating requireme equal to both the standardized minim and maximum design heating requireme defined below, calculate the HSPF defin as:

$$HSPF=\frac{\sum_j \frac{n_j}{N}BL(T_j)}{\left[\sum_j \frac{E(T_j)}{N}+\sum_j \frac{RH(T_j)}{N}\right]}$$

where

$\sum_j$ as defined in 5.2.1

$\frac{n_j}{N}$ as defined in 5.2.1

T_j as defined in 5.2.1

and $BL(T_j)$ is the building load at temp ature T_j, in Btu/hr, calculated by:

$$BL(T_j)=\left(\frac{65-T_j}{65-T_{OD}}\right)\times(C)\times(DHR)$$

where

(C) = 0.77 is a correction factor which tend improve the agreement between calcula and measured building loads

(DHR) = the minimum and maximum design hea requirement which the heat pump is lik to encounter when installed in a reside rounded off to the nearest standar DHR in section 6.2.6 in Btu's per hour

where

(minimum design heating requirement)

$$=\begin{cases}\dot{Q}_{ss}^{(k=1)}(47)\,\dfrac{(65-T_{OD})}{60}, \text{ for regions I,}\\ \qquad\text{II, III, IV, and V}\\ \dot{Q}_{ss}^{(k=1)}(47), \text{ for region V}\end{cases}$$

and

(maximum design heating requirement)

$$=\begin{cases}2\dot{Q}_{ss}^{(k=2)}(47)\,\dfrac{(65-T_{OD})}{60}, \text{ for regions I,}\\ \qquad\text{II, III, IV and V}\\ 2.2\dot{Q}_{ss}^{(k=2)}(47) \text{ for region V}\end{cases}$$

where

$\dot{Q}_{ss}^{(k=2)}(47)$ is the heat pump capacity measured d ing the high temperature perform test at 47°F, with the unit operating the high compressor speed or with b compressors in operation, in Btu/hr

T_{OD} is the outdoor design temperature gi in section 6.2.4 in degrees °F.

NOTE: The superscript $(k=1)$ and $(k=$ refer to the heat pump operating at l speed or single compressor operation a high speed or two compressor operati respectively.

$\frac{E(T_j)}{N}$ is the heat pump electrical energy usage in the j^{th} temperature bin divided by the total number of bin hours and is evaluated according to the four possible cases of heat pump operation denoted below in watts.

$\frac{RH(T_j)}{N}$ as defined in 5.2.1 and is evaluated according to the four possible cases of heat pump operation denoted below (in watts).

Case I.—Units operating at low compressor speed or with a single compressor, i.e., $k=1$, for which the building heating load, $BL(T_j)$ is less than or equal to the heating capacity, $\dot{Q}^{k=1}(T_j)$.

$$BL(T_j) \leq \dot{Q}^{k=1}(T_j)$$

$$\frac{E(T_j)}{N} = \frac{\dot{E}^{k=1}(T_j)X^{k=1}(T_j)\delta'(T_j)}{PLF^{k=1}}\frac{n_j}{N}$$

$$\frac{RH(T_j)}{N} = \frac{\frac{n_j}{N}BL(T_j)[1-\delta'(T_j)]}{3.413}$$

$$X^{k=1}(T_j) = \frac{BL(T_j)}{\dot{Q}^{k=1}(T_j)}$$

$$PLF^{k=1} = 1 - C_D^{k=1}(1 - X_j^{k=1})$$

$$\delta'(T_j) = \begin{cases} 0; & T_j \leq T_{OFF} \\ \frac{1}{2}; & T_{OFF} < T_j \leq T_{ON} \\ 1; & T_j > T_{ON} \end{cases}$$

Case II.—Units alternating between high speed or two compressor operation ($k=2$) and low speed or single compressor operation ($k=1$) to satisfy the building heating load at temperature T_j.

$$\dot{Q}^{k=1}(T_j) < BL(T_j) < \dot{Q}^{k=2}(T_j)$$

$$\frac{E(T_j)}{N} = [\dot{E}^{k=1}(T_j)X^{k=1}(T_j) + \dot{E}^{k=2}(T_j)X^{k=2}(T_j)]\delta'(T_j)\frac{n_j}{N}$$

$$\frac{RH(T_j)}{N} = \frac{\frac{n_j}{N}BL(T_j)[1-\delta'(T_j)]}{3.413}$$

$$X^{k=1}(T_j) = \frac{Q^{k=2}(T_j) - BL(T_j)}{\dot{Q}^{k=2}(T_j) - \dot{Q}^{k=1}(T_j)}$$

$$X^{k=2}(T_j) = 1 - X^{k=1}(T_j)$$

$$\delta'(T_j) \begin{cases} 0; & T_j \leq T_{OFF} \\ \frac{1}{2}; & T_{OFF} < T_j \leq T_{ON} \\ 1; & T_j > T_{ON} \end{cases}$$

Case III.—Units cycling on and off at high compressor speed or cycling both compressors on and off together ($k=2$) in order to satisfy the building heating load at temperature T_j.

$$\dot{Q}^{k=1}(T_j) < BL(T_j) < \dot{Q}^{k=2}(T_j)$$

$$\frac{E(T_j)}{N} = \frac{\dot{E}^{k=2}(T_j)X^{k=2}(T_j)\delta''(T_j)\frac{n_j}{N}}{PLF^{k=2}}$$

$$\frac{RH(T_j)}{N} = \frac{\frac{n_j}{N}BL(T_j)[1-\delta''(T_j)]}{3.413}$$

$$X^{k=2}(T_j) = \frac{BL(T_j)}{\dot{Q}^{k=2}(T_j)}$$

$$PLF^{k=2} = 1 - C_D^{k=2}(1 - X^{k=2}(T_j))$$

$$\delta''(T_j) = \begin{cases} 0; & T_j \leq T_{OFF} \\ \frac{1}{2}; & T_{OFF} < T_j \leq T_{ON} \\ 1; & T_j > T_{ON} \end{cases}$$

Case IV.—Units operating continuously at high compressor speed or with both compressors in continuous operation ($k=2$) in order to satisfy the building heating load at temperature T_j.

$$BL(T_j) \geq \dot{Q}^{k=2}(T_j)$$

$$\frac{E(T_j)}{N} = \dot{E}^{k=2}(T_j)X^{k=2}(T_j)\delta''(T_j)\frac{n_j}{N}$$

$$\frac{RH(T_j)}{N} = \frac{[BL(T_j) - \dot{Q}^{k=2}(T_j)X^{k=2}(T_j)\delta''(T_j)]\frac{n_j}{N}}{3.413}$$

$$X^{k=2}(T_j) = 1.0$$

$$\delta''(T_j) = \begin{cases} 0; \; T_j \leq T_{OFF} & \text{or } \frac{\dot{Q}^{k=2}(T_j)}{(3.413)(\dot{E}^{k=2}(T_j))} < 1 \\ \frac{1}{2}; \; T_{OFF} < T_j \leq T_{ON} & \text{and } \frac{\dot{Q}^{k=2}(T_j)}{(3.413)(\dot{E}^{k=2}(T_j))} \geq 1 \\ 1; \; T_j \geq T_{ON} & \text{and } \frac{\dot{Q}^{k=2}(T_j)}{(3.413)(\dot{E}^{k=2}(T_j))} \geq 1 \end{cases}$$

Where in each of the above cases

$X(T_j)$ = heat pump heating load factor.

PLF = heat pump part load factor (not required for cases II and IV.)

$\delta''(T_j)$ = heat pump low temperature cut-out factor.

T_{off} as defined in 5.2.1.

T_{on} as defined in 5.2.1.

$C_D^{(k=2)}$ = the part load degradation factor described in section 2.2.1 and 5.2 for the unit cycling at high compressor speed or with both compressors simultaneously cycling (if applicable).

$C_D^{(k=1)}$ = the part load degradation factor described in section 2.2.1 and 5.2 for the unit cycling at low compressor speed or with the single compressor that normally operates at low heating loads.

$$\dot{Q}^{k=1}(T_j)=\begin{cases} \dot{Q}_{ss}^{k=1}(47)+\dfrac{(\dot{Q}_{ss}^{k=1}(62)-\dot{Q}_{ss}^{k=1}(47))\times(T_j-47)}{15}; & T_j\geq 40^\circ\text{ F} \\ \dot{Q}_{ss}^{k=1}(17)+\dfrac{(\dot{Q}_{def}^{k=1}(35)-\dot{Q}_{ss}^{k=1}(17))\times(T_j-17)}{18}; & 17^\circ\text{ F}\leq T_j<40^\circ\text{ F} \\ \dot{Q}_{ss}^{k=1}(17)+\dfrac{(\dot{Q}_{ss}^{k=1}(47)-\dot{Q}_{ss}^{k=1}(17))\times(T_j-17)}{30}; & T_j<17^\circ\text{ F} \end{cases}$$

$$\dot{Q}^{k=2}(T_j)=\begin{cases} \dot{Q}_{ss}^{k=2}(17)+\dfrac{(\dot{Q}_{ss}^{k=2}(47)-\dot{Q}_{ss}^{k=2}(17))\times(T_j-17)}{30}; & T_j\geq 45^\circ\text{ F or }T_j\leq 17^\circ\text{ F} \\ \dot{Q}_{ss}^{k=2}(17)+\dfrac{(\dot{Q}_{def}^{k=2}(35)-\dot{Q}_{ss}^{k=2}(17))\times(T_j-17)}{18}; & 17^\circ\text{ F}<T_j<45^\circ\text{ F} \end{cases}$$

$$\dot{E}^{k=1}(T_j)=\begin{cases} \dot{E}_{ss}^{k=1}(47)+\dfrac{(\dot{E}_{ss}^{k=1}(62)-\dot{E}_{ss}^{k=1}(47))\times(T_j-47)}{15}; & T_j\geq 40^\circ \\ \dot{E}_{ss}^{k=1}(17)+\dfrac{(\dot{E}_{def}^{k=1}(35)-\dot{E}_{ss}^{k=1}(17))\times(T_j-17)}{18}; & 17^\circ\text{ F}\leq T_j<40^\circ \\ \dot{E}_{ss}^{k=1}(17)+\dfrac{(\dot{E}_{ss}^{k=1}(47)-\dot{E}_{ss}^{k=1}(17))\times(T_j-17)}{30}; & T_j<17^\circ \end{cases}$$

$$\dot{E}^{k=2}(T_j)=\begin{cases} \dot{E}_{ss}^{k=2}(17)+\dfrac{(\dot{E}_{ss}^{k=2}(47)-\dot{E}_{ss}^{k=2}(17))\times(T_j-17)}{30}; & T_j\geq 45^\circ\text{ F or }T_j\leq 17^\circ \\ \dot{E}_{ss}^{k=2}(17)+\dfrac{(\dot{E}_{def}^{k=2}(35)-\dot{E}_{ss}^{k=2}(17))\times(T_j-17)}{18}; & 17^\circ\text{ F}<T_j<45^\circ \end{cases}$$

For each of the six regions specified i section 6.2.5, calculate the heating seasona performance factors and seasonal operatin costs corresponding to the standardize maximum and minimum design heatin requirements and for all other standardize design heating requirements (see sectio 6.2.6) between the maximum and th minimum.

5.2.3 ***Heating seasonal performan factor for air-source units with tripl capacity compressors.*** **(Reserved)**

5.2.4 ***Heating seasonal performan factor for units with variable-spe compressors.*** **For units with variabl speed compressors, the heating seaso al performance factor (HSPF) is d fined by the following equation:**

$$HSPF=\frac{\sum_j \frac{n_j}{N} BL(T_j)}{\left(\sum_j \frac{E(T_j)}{N} + \sum_j \frac{RH(T_j)}{N}\right)}$$

where all symbols in the above equations are as defined in 5.2.2.

The minimum and maximum heating design requirements, DHR_{min} and DHR_{max}, which a variable-speed heat pump is likely to encounter, shall be evaluated as described for two-speed units in 5.2.2 with the option of using the nominal capacity, $Q_{ss}^{k=n}(47°F)$, in lieu of the maximum speed capacity, $Q_{ss}^{k=2}(47)$, in the prescribed equations if the manufacturer performed the nominal capacity test.

In evaluation of HSPF, three cases are considered, the quantities $\frac{E(T_j)}{N}$ and $\frac{RH(T_j)}{N}$ shall be calculated depending on compressor mode of operation.

Case I

The compressor operates at the minimum speed (k=1) for which the building heating load, $BL(T_j)$, is less than or equal to the heating capacity, $Q_{ss}^{k=1}(T_j)$.

Calculations shall be performed as prescribed for two-speed systems in Case I of 5.2.2 with the exception that system capacity $Q_{ss}^{k=1}(T_j)$, and power, $E_{ss}^{k=1}(T_j)$, shall be calculated by the following equations:

$$Q_{ss}^{k=1}(T_j)=Q_{ss}^{k=1}(47)+\frac{Q_{ss}^{k=1}(62)-Q_{ss}^{k=1}(47)}{15}*(T_j-47)$$

$$E_{ss}^{k=1}(T_j)=E_{ss}^{k=1}(47)+\frac{E_{ss}^{k=1}(62)-E_{ss}^{k=1}(47)}{15}*(T_j-47)$$

Case II

The compressor operates at any intermediate (k=v) speed between the maximum speed (k=2) and minimum (k=1) speed to satisfy the building load and evaluate the following equations:

$$Q^{k=v}(T_j)=BL(T_j)$$

$$\frac{Q(T_j)}{N}=Q^{k=v}(T_j)*\frac{n_j}{N}$$

$$E^{k=v}(T_j)=\frac{Q^{k=v}(T_j)}{3.413*COP^{k=v}(T_j)}$$

$$\frac{E(T_j)}{N}=E^{k=v}(T_j)*\frac{n_j}{N}$$

where

$Q^{k=v}(T_j)$ = capacity delivered by the unit at any intermediate speed between the minimum and maximum compressor speed matching the building load at temperature T_j

$E^{k=v}(T_j)$ = the electrical power input required by the unit at temperature T_j to deliver capacity matching the building load

$COP^{k=v}(T_j)$ = the coefficient of performance at which the unit delivers capacity matching the building load at temperature T_j

Before the coefficient of performance, $COP^{k=v}(T_j)$, can be calculated, the unit performance has to be evaluated at the compressor speed (k=i) at which the intermediate speed test was conducted. The capacity of the unit at any temperature T_j when compressor operates at the intermediate speed (k=i) may be determined by:

$$Q_{def}^{k=i}(T_j)=Q_{def}^{k=i}(35)+M_Q(T_j-35)$$

where

$Q_{def}^{k=i}(35)$ = the capacity of the unit at 35°F determined at the intermediate compressor speed (k=i) in the frost accumulation test

M_Q = slope of the capacity curve for the intermediate compressor speed (k=i)

$$M_Q=\frac{Q_{ss}^{k=1}(62)-Q_{ss}^{k=1}(47)}{62-47}*(1-N_Q)+N_Q\frac{Q_{def}^{k=2}(35)-Q_{ss}^{k=2}(17)}{35-17}$$

$$N_Q=\frac{Q_{def}^{k=i}(35)-Q_{ss}^{k=1}(35)}{Q_{def}^{k=2}(35)-Q_{ss}^{k=1}(35)}$$

Once the equation for $Q^{k=i}(T_j)$ has been determined, the temperature where $Q_{def}^{k=i}(T_j)=BL(T_j)$ can be found. This temperature is designated at T_{vh}. A separate T_{vh} shall be determined for each design heating requirement.

The electrical power input for the unit operating at the intermediate compressor speed (k=v) and at the temperature (T_{vh}) is determined by:

$$E^{k=i}_{def}(T_{vh})=E^{k=i}_{def}(35)+M_E(T_{vh}-35)$$

where

$E^{k=i}_{def}(35)$ = the electrical power input of the unit at 35°F determined at the intermediate compressor speed (k=i) in the frost accumulation test

M_E = slope of the electrical power input curve for the intermediate compressor speed (k=i)

$$M_E \quad \frac{E^{k=1}_{ss}(62)-E^{k=1}_{ss}(47)}{62-47}*(1-N_E)$$

$$+N_E\frac{E^{k=2}_{def}(35)-E^{k=2}_{ss}(17)}{35-17}$$

$$N_E \quad \frac{E^{k=i}_{def}(35)-E^{k=1}_{ss}(35)}{E^{k=2}_{def}(35)-E^{k=1}_{ss}(35)}$$

The coefficient of performance, $COP^{k=i}(T_{vh})$, at the intermediate speed (k=i) and temperature T_{vh} can be calculated by the equation:

$$COP^{k=i}(T_{vh})=\frac{Q^{k=i}_{def}(T_{vh})}{3.413*E^{k=i}_{def}(T_{vh})}$$

Similarly, coefficients of performance at temperature T_3 and T_4 can be calculated by the equations:

$$COP^{k=1}(T_3)=\frac{Q^{k=1}(T_3)}{3.413*E^{k=1}(T_3)}$$

$$COP^{k=2}(T_4)=\frac{Q^{k=2}(T_4)}{3.413*E^{k=2}(T_4)}$$

where

T_3 = temperature at which the unit, operating at the minimum compressor speed, delivers capacity equal to the building load ($Q^{k=1}(T_3)=BL(T_3)$), found by equating the capacity by using the equation $Q^{k=1}(T_j)$ (at T_j>40°F) equal to the building load equation $BL(T_j)$ as identified in section 5.2.2 of this Appendix and solving for temperature

T_4 = temperature at which the unit, operating at the maximum, delivers capacity equal to the building load ($Q^{k=2}(T_4)=BL(T_4)$), found by setting the equation for capacity $Q^{k=2}(T_j)$ equal to the equation for building load $BL(T_j)$ from the two-speed procedure in section 5.2.2 and solving for temperature

$COP^{k=1}(T_3)$ = the coefficient of performance at the minimum compressor speed at temperature T_3

$COP^{k=2}(T_4)$ = the coefficient of performance at the maximum compressor speed at temperature T_4

$Q^{k=1}(T_3)$ = steady-state capacity at the minimum compressor speed at temperature T_3 using equations $Q^{k=1}(T_j)$ from the two-speed procedure

$Q^{k=2}(T_4)$ = steady-state capacity at the maximum compressor speed at temperature T_4 calculated using the equation for $Q^{k=2}(T_j)$ of the two-speed procedure.

$E^{k=1}(T_3)$ = the electrical power input at the minimum compressor speed at temperature T_3, calculated by using the equation for $E^{k=1}(T_j)$ (where T_j>40°F) from the two-speed procedure in section 5.2.2 of this Appendix

$E^{k=2}(T_4)$ = the electrical power input at the maximum compressor speed at temperature T_4, calculated by using the equation for $E^{k=2}(T_j)$ from the two-speed procedure in section 5.2.2 of this Appendix

The coefficient of performance, $COP^{k=v}(T_j)$, shall be calculated by the following equation:

$$COP^{k=v}(T_j)=A+B*T_j+C*T_j^2$$

where coefficients A, B and C shall be evaluated using the following calculations step:

$$D=\frac{T_3{}^2-T_4{}^2}{T_{vh}{}^2-T_4{}^2}$$

$$B=\frac{\mathrm{COP}^{k=1}(T_4)-\mathrm{COP}^{k=1}(T_3)-D^{*}[\mathrm{COP}^{k=1}(T_4)-\mathrm{COP}^{k=1}(T_{vh})]}{T_4-T_3-D^{*}(T_4-T_{vh})}$$

$$C=\frac{\mathrm{COP}^{k=1}(T_4)-\mathrm{COP}^{k=1}(T_3)-B^{*}(T_4-T_3)}{T_4^{2}-T_3^{2}}$$

$$A=\mathrm{COP}^{k=1}(T_4)-B^{*}T_4-C^{*}T_4^{2}$$

Case III

The compressor operates at the maximum speed (k = 2) for which the building heating load, $BL(T_j)$, is greater than or equal to the heating capacity, $Q_{h}^{k=2}(T_j)$.

Calculations shall be performed as prescribed for two-speed systems in Case IV of 5.2.2.

5.2.5 *Heating seasonal performance factor for split-type ductless systems.* For split-type ductless systems, HSPF shall be defined as specified in section 5.2.1 of this Appendix. Separate values of HSPF shall be determined for each corresponding combination set of indoor coils used in the development of SEER as specified in Section 5.1.7. The calculations used shall be the same as those used for units with the same type of compressor.

5.3 *Calculations of the Actual Representative Regional Annual Performance Factors for Air Source Central Air Conditioners (Heat Pumps) Which Provide Both Heating and Cooling.*

5.3.1 Calculation of actual regional annual performance factors (APF_A) for a particular location and for each standardized design heating requirement.

$$(APF_A)=\frac{(CLH_A)(\dot{Q}_{ss}^{k}(95F))+(HLH_A)(DHR)(C)}{\dfrac{(CLH_A)(\dot{Q}_{ss}^{k}(95F))}{(SEER)}+\dfrac{(HLH_A)(DHR)(C)}{(HSPF)}}$$

where

(CLH_A) is the actual cooling load hours for the particular location, determined from the map in section 6.1.3.

$(\dot{Q}_{ss}^{k}(95F))$ is defined in 5.1.

(DHR) is defined in 5.2.2.

(C) is defined in 5.2.2.

(HLH_A) is the actual heating load hours for the particular location determined from the map in section 6.2.5.

$(SEER)$ is the seasonal energy efficiency ratio determined in section 5.1.

$(HSPF)$ is the heating seasonal performance factors as determined in section 5.2 for each standardized design heating requirement within the particular location's region or for the actual design heating requirement if known.

where the particular location's region is determined from the map in section 6.2.5 and, the standardized design heating requirements within the region are determined in sections 5.2 and 6.2.6.

5.3.2 Calculation of representative regional annual performance factors (APF_R) for each region and for each standardized design heating requirement.

$$(APF_R)=\frac{(CLH_R)(\dot{Q}_{ss}^{k}(95F))+(HLH_R)(DHR)(C)}{\dfrac{(CLH_R)(\dot{Q}_{ss}^{k}(95F))}{SEER}+\dfrac{(HLH_R)(DHR)(C)}{HSPF}}$$

$(\dot{Q}_{ss}^{k}(95F))$ is defined in 5.1.

(DHR) is defined in 5.2.2.

(C) is defined in 5.2.2.

where

(CLH_R) is the representative cooling load hours for each heating load hours region, as determined in section 6.3.

(HLH_R) is the representative heating load hours for each region as determined in section 6.2.5.

$(SEER)$ is the seasonal energy efficiency ratio as determined in section 5.1.

$(HSPF)$ is the heating seasonal performance factor as determined in section 5.2 for each region and for each standardized design heating requirement within each region.

where the regions are listed in section 6.2.5 and, the standardized design heating requirements within the regions are determined in sections 5.2 and 6.2.6.

6.0 *Reference material.*

6.1 *Cooling reference material.*

6.1.1 *Test operating and test condition tolerance for cyclic dry-coil tests.*

Readings, remarks	Test operating tolerance[1]	Test condition tolerance[2]
Outdoor dry-bulb air temperature, Fahrenheit: Entering	2.0	0.5
Indoor dry-bulb air temperature, Fahrenheit: Entering	2.0	0.5
Indoor wet-bulb air temperature, Fahrenheit: Entering	(³)	(³)
After the first 30 sec after compressor startup:		
External resistance to airflow, inches water	0.05	0.02
Nozzle pressure drops, percent of reading	2.0	
Electrical voltage inputs to the test unit, percent	2.0	

[1] Total observed range.

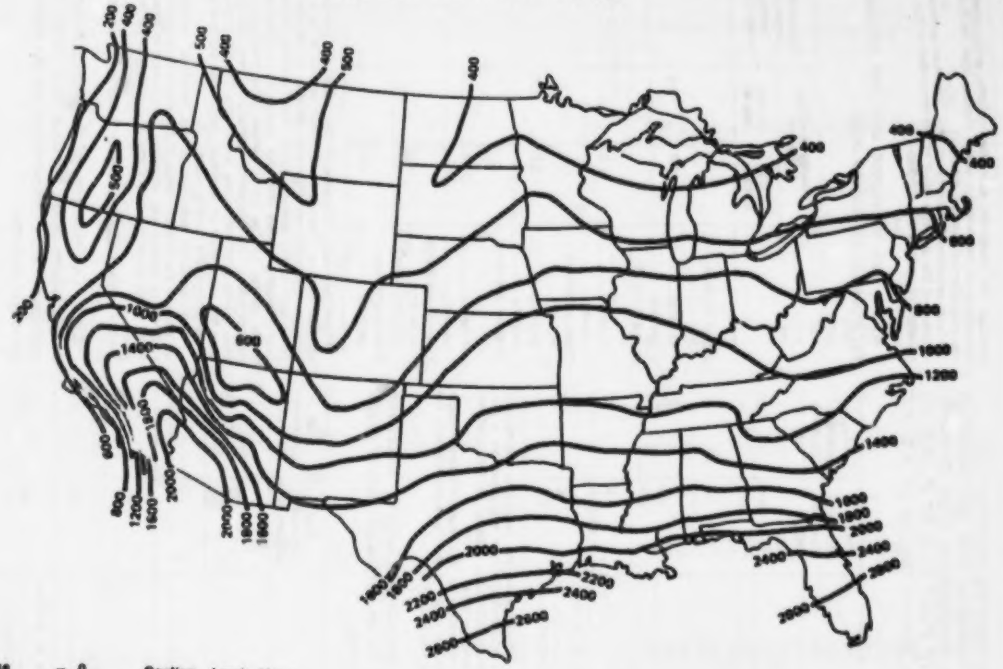
[2] Variation of average from specified test condition.

[3] Shall at no time exceed that value of the wet-bulb temperature which results in the production of condensate by the indoor coil at the dry-bulb temperature existing for the air entering the indoor portion of the unit.

6.1.2 *Distribution of fractional hours in temperature bins to be used for calculation of the SEER for 2-speed compressor and 1-compressor units.*

Bin No. j:	Bin temperature range (degrees Fahrenheit)	Representative temperature bin for (degrees Fahrenheit)	Fraction of total temperature bin hours n_j/N
1	65–69	67	[illegible]
2	70–74	72	[illegible]
3	75–79	77	[illegible]
4	80–84	82	[illegible]
5	85–89	87	[illegible]
6	90–94	92	[illegible]
7	95–99	97	[illegible]
8	100–104	102	[illegible]

6.1.3 Distribution of Actual Cooling Load Hours (CLH_A) Throughout the United States


200
400
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2000
2200
2400
2600
500
600
1000
1400
1800
2000
1600
1200
800
600
200

Alaska – 0 Cooling Load Hours
Canal Zone – 6,000 " " "
Guam – 6,800 " " "
Hawaii – 2,300 " " "
Puerto Rico – 6,000 " " "
Samoa – 6,800 " " "
Virgin Island – 6,300 " " "

6.2 *Heating reference material.*

6.2.1 *Test operating and test condition tolerance for Steady-State High Temperature Test [at 47° F (8.3° C) or 62° F (16.7° C)] and Low Temperature Test [at 17° F (−8.3° C)].*

	Test operating[1] tolerance	Test condition[2] tolerance
Indoor dry-bulb, ° F:		
Entering	2.0	0.5
Leaving	2.0	
Indoor wet-bulb, ° F:		
Entering	1.0	
Leaving	1.0	
Outdoor dry-bulb, ° F:		
Entering	2.0	0.5
Leaving	2.0	
Outdoor wet-bulb, ° F:		
Entering	1.0	0.3
Leaving	1.0	
External resistance to air flow, inches of water	.05	.02
Electrical voltage, percent	2.0	

[1] Test operating tolerance is the maximum permissible variation of any measurement. When expressed as a percentage, the maximum allowable variation is the specified percentage of the average value.

[2] Test condition tolerance is the maximum permissible variation of the average value of the measurement from the standard or desired test condition.

6.2.2 *Test operating and test condition tolerances for the on-period portion of cyclic performance tests.*

	Test operating tolerances[1]	Test condition tolerance[2]
Indoor dry-bulb, ° F:		
Entering	2.0	0.5
Leaving		
Indoor wet-bulb, ° F:		
Entering	1.0	
Leaving		
Outdoor dry-bulb, ° F:		
Entering	2.0	0.5
Leaving		
Outdoor wet-bulb, ° F:		
Entering	2.0	1.0
Leaving		
External resistance to air-flow, inches of water	.05	.02
Electrical voltage, percent	2.0	

[1] Test operating tolerance is the maximum permissible variation of any measurement. When expressed as a percentage, the maximum allowable variation is the specifie percentage of the average value. (Applies after the first 3 seconds after compressor start-up.)

[2] Test condition tolerance is the maximum permissib variation of the average value of the measurement from th standard or desired test condition.

6.2.3 *Test operating and test tolerances for frost accumulation tests.*

	Testing operating tolerance[1]		Test conditi tolerance[2] (heating portion only)
	During heating	During defrost	
Indoor dry-bulb, ° F:			
Entering	2.0	[3]4.0	0.5
Leaving			
Indoor wet-bulb, ° F:			
Entering	1.0		
Leaving			
Outdoor dry-bulb, ° F:			
Entering	2.0	10.0	1.0
Leaving			
Outdoor dew-point, ° F:			
Entering	1.5		0.7
Leaving			
External resistance to air-flow, inches of water	.05		.02
Electrical voltage, percent	2.0		

[1] Test operating tolerance is the maximum permissib variation of any measurement. When expressed as a pe centage, the maximum allowable variation is the specifie percentage of the average value. Test Operating Toleranc During Heating applies when the heat pump is in the heatin mode, except for the first 5 minutes after termination of defrost cycle. Test Operating Tolerance During Defrost a plies during a defrost cycle and during the first 5 minut after the termination of a defrost cycle when the heat pum is operating in the heating mode.

[2] Test condition tolerance is the maximum permissib variation of the average value of the measurement from th standard or desired test condition. Test Condition Toleranc applies only when the heat pump is operating in the heatin mode.

[3] Not applicable during defrost if the indoor fan is o

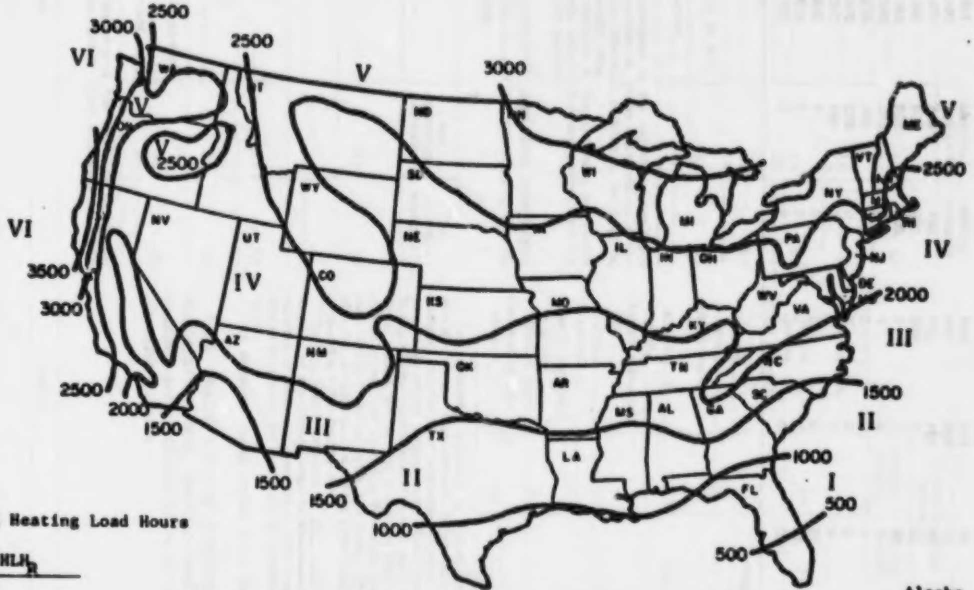
6.2.4 *Distribution of fractional hours in temperature bins, heating load hours and outdoor design temperature for the differen climatic regions.*

Fractional hours		Region					
Bin No.	T_j (°F)	I	II	III	IV	V	VI
		Heating Load Hours, HLH					
		750	1,250	1,750	2,250	2,750	[1]2,75
		Outdoor Design Temperature, T_{OD}, for the region					
		37	27	17	5	-10	3
j=1	62	.291	.215	.153	.132	.106	.10

Fractional hours		Region					
Bin No.	T_j (°F)	I	II	III	IV	V	VI
2	57	.239	.189	.142	.111	.092	.206
3	52	.194	.163	.138	.103	.086	.215
4	47	.129	.143	.137	.093	.076	.204
5	42	.081	.112	.135	.100	.078	.141
6	37	.041	.088	.118	.109	.087	.076
7	32	.019	.056	.092	.126	.102	.034
8	27	.005	.024	.047	.087	.094	.008
9	22	.001	.008	.021	.055	.074	.003
10	17	0	.002	.009	.036	.055	0
11	12	0	0	.005	.026	.047	0
12	7	0	0	.002	.013	.038	0
13	2	0	0	.001	.006	.029	0
14	-3	0	0	0	.002	.018	0
15	-8	0	0	0	.001	.010	0
16	-13	0	0	0	0	.005	0
17	-18	0	0	0	0	.002	0
18	-23	0	0	0	0	.001	0

[1] Pacific Coast Region.

6.2.5 Actual heating load hours (HLH_A) and regional heating load hours (HLH_R) for the United States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TX
LA
FL

This map is reasonably accurate for most parts of the United States but is necessarily highly generalized, and consequently not too accurate in mountainous regions, particularly in the Rockies

Alaska - 3500 HLH
Hawaii and Territories - 0 HLH

Regional Heating Load Hours

Region	HLH_R
I	750
II	1250
III	1750
IV	2250
V	2750
VI	[illegible]

6.2.6 *Standard Design Heating Requirements (Btu/hr)*

5,000	25,000	50,000	90,000
10,000	30,000	60,000	100,000
15,000	35,000	70,000	110,000
20,000	40,000	80,000	130,000

6.3 *Representative Cooling Load Hours* (CLH_R) for Each Heating Load Hours Region.

Region	CLH_R	HLH_R
I	2,400	750
II	1,800	1,250
III	1,200	1,750
IV	800	2,250
V	400	2,750
VI	200	2,750

6.4 *Ground Water Temperature Map* (Reserved).

[44 FR 76707, Dec. 27, 1979, as amended at 54 FR 6076, Feb. 7, 1989]

APPENDIX N TO SUBPART B OF PART 430—UNIFORM TEST METHOD FOR MEASURING THE ENERGY CONSUMPTION OF FURNACES

1. *Definitions.* Definitions shall include the definitions specified in section 3.0 of ANSI/ASHRAE 103-82 and the following additional definitions:

1.1 "ASHRAE" means the American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.

1.2 "ANSI/ASHRAE 103-82" means the test standard published in 1982 by ASHRAE, approved by the American National Standards Institute (ANSI) on June 21, 1983 and titled "Methods of Testing for Heating Seasonal Efficiency of Central Furnaces And Boilers."

1.3 "Electro-mechanical stack damper" means a type of stack damper which is operated by electrical and/or mechanical means.

1.4 "Isolated combustion system" means an installation in which a furnace is installed indoors and all combustion and ventilation air is admitted through grills or ducts from outdoors and (all such air) does not communicate with air in the conditioned space.

1.5 "Modulating control" means either a step modulating or a "two-stage control"

1.6 "Reduced heat input rate" means the factory adjusted lowest reduced heat input rate for furnaces equipped with either two stage thermostats or step-modulating thermostats.

1.7 "Single stage thermostat" means a thermostat that cycles a burner from the maximum heat input rate and off.

1.8 "Step-modulating control" means a modulating control that cycles a burner from the reduced input rate to off if the heating load is light. If a higher heating load is encountered which cannot be met with the reduced input rate, the control either gradually increases or steps up the input rate to meet the higher heating load. At that point if a lower heating load is encountered, the control either gradually decreases or steps down to a lower rate, or gradually increases the heat input to meet any higher heating load that cannot be met with the low firing rate.

1.9 "Thermal stack damper" means a type of stack damper which is dependent for operation exclusively upon the direct conversion of thermal energy of the stack gases into closure of the damper.

1.10 "Two stage control" means a modulating control that cycles a burner from reduced heat input rate and off or cycles a burner at the maximum heat input rate and off.

2.0 *Testing conditions.* The testing conditions shall be as specified in section 8 of ANSI/ASHRAE 103-82 with the exception of section 8.4.2.3, and the inclusion of the following additional testing conditions:

2.1 *Gas burner adjustment at maximum input rate.* The following paragraph is in addition to the requirements specified in section 8.4.1.1 of ANSI/ASHRAE 103-82:

For gas fueled furnaces and boilers equipped with modulating type controls, adjust the controls to operate the unit at the maximum fuel input rate. Set the thermostat control to the maximum setting. Start the furnace or boiler by turning the safety control valve to the "on" position. Use a supply water temperature for boilers that will allow for continuous operation without shut off by the thermostat control.

2.2 *Gas burner adjustment at reduced input rate.* The following paragraph is in addition to the requirements specified in section 8.4.1.1 of ANSI/ASHRAE 103-82:

For gas fueled furnaces and boilers equipped with modulating type thermostat controls, adjust the controls to operate the unit at the reduced fuel input rate. Set the thermostat control to the lowest setting that does not cause the burner to cycle on and off. Start the furnace or boiler by turning the safety control valve to the "on" position. Use supply water temperature for boilers that will allow for continuous operation without shut off by the thermostat control. If necessary, supply water may be increased above 120° F in order to maintain continuous operation at the reduced setting.

2.3 *Gas and oil fueled low pressure steam and hot water boilers (including direct vent* *systems*). The following paragraphs are in place of section 8.4.2.3 of ANSI/ASHRAE 103-82:

For non-condensing hot water boilers, the water flow rate shall be adjusted to produce a water temperature rise, during the steady-state test described in section 9.1 of ANSI/ASHRAE 103-82, of 19° F -24° F. During the steady-state and heat-up tests, the hot water boiler shall be supplied with water having a temperature of at least 120° F but not more than 124° F.

For steam boilers, the pressure shall be at atmospheric or at a pressure not exceeding 2 psig during the steady-state test.

3.0 *Test procedure.* Testing and measurements shall be as specified in section 9 of ANSI/ASHRAE 103-82 with the exception of sections 9.2.2 and 9.3.2, and the inclusion of the following additional procedures:

3.1 *Gas fueled gravity furnaces, forced air central furnaces, and low pressure steam and hot water boilers (including direct vent systems, excluding condensing furnaces or boilers).* The following paragraphs are in addition to the requirements specified in section 9.1.1 of ANSI/ASHRAE 103-82:

For all gas fueled furnaces and boilers, the steady-state efficiency shall be determined at the maximum fuel input rate measured in accordance with sections 2.1 of this appendix and section 9.1.1 of ANSI/ASHRAE 103-82. Also, for gas fueled furnaces and boilers equipped with either two stage thermostats or step-modulating thermostats, the steady-state efficiency shall also be determined at the reduced fuel input rate measured in accordance with sections 2.2 of this appendix and section 9.1.1 of ANSI/ASHRAE 103-82.

In addition, for gas fueled furnaces and boilers equipped with draft hoods, measure CO_2 in stack after dilution during the steady state condition.

3.2 *Flue temperature measurements—cool down test.* The following paragraphs are in addition to the requirements specified in section 9.2 of ANSI/ASHRAE 103-82:

For furnaces and boilers equipped with step-modulating thermostats, the cool down test shall be conducted after steady-state conditions have been reached at the reduced input rate, as specified in section 2.2 of this appendix. For furnaces and boilers equipped with two stage controls, separate cool down tests shall be conducted after steady-state conditions have been reached at both the reduced and maximum fuel input rates.

3.3 *Gas and oil fueled boilers—cool down test.* The following paragraphs are in place of the requirements specified in section 9.2.2 of ASHRAE 103-82:

After steady-state testing has been completed, turn the main burner(s) off and measure the flue gas temperature at 3.75 ($T_{F,OFF(t3)}$) and 22.5 ($T_{F,OFF(t4)}$) minutes after the burner shuts off, using the thermocouple grid described above. During th period for units that do not have delay after shut-off, no water shall b lowed to circulate through the hot boilers. For units that have pump dela shut-off, except those having pump co sensing water temperature, the pum be stopped by the unit control and the t*, between burner shut-off and pump off shall be measured within one se curacy. For units having pump delay trols which sense water temperature, pump shall be operated for 15 minute t* shall be 15 minutes. While the pump operating, the inlet water temperature flow rate shall be maintained at the values as used during the preceding st state test.

Make a third flue gas temperature m urement 45 minutes after the burner off to determine the off-period mini flue gas temperature ($T_{F,OFF(t-)}$).

During this cool down test, measure energy input rate to the pilot light (Q the unit is so equipped, to within an no larger than ± 3 percent. Record all ured values. For oil fueled units equipped with stack dampers, maintain draft in the flue within the same r specified in section 9.2.1 of ANSI/AS 103-82. For direct vent systems with dampers or boilers equipped with both dampers and barometric dampers, clos flue or stack damper during the cool test.

3.4 *Flue gas temperature measurem heat-up test.* The following paragraph i addition to the requirement specified in tion 9.3 of ANSI/ASHRAE 103-82.

For furnaces and boilers equipped step-modulating thermostats, the hea test shall be conducted at the reduced input rate, as specified in section 2.2 of appendix. For furnaces and boilers equ with two stage controls, separate hea tests shall be conducted at both the red and maximum fuel input rates.

3.5 *Gas and oil fueled boilers.* The fo ing paragraph is in place of the requ ments specified in section 9.3.2 of A ASHRAE 103-82.

Fifty minutes or more after the burner(s) is turned off for the cool test, turn on the steam or hot water and measure the flue gas temperature a ($T_{F,ON(t1)}$) and 5.5 ($T_{F,ON(t2)}$) minutes after main burners are turned on. The pump culating the water through the hot boiler shall be started simultaneously the main burner(s). The water flow shall be the same as that maintained d the steady-state test described in section of ANSI/ASHRAE 103-82. During the up test for oil fired boilers maintain draft in the flue pipe within ± 0.01 in water column of the manufacturer's r measured on-period draft. Record the measured temperatures.

3.6 *Direct measurement of condensate.* For condensing furnaces and boilers, the condensate heat loss shall be determined either by the method specified in section 11.3.33 of ANSI/ASHRAE 103–82 or by the following test procedures:

Control devices shall be installed to allow cyclical operation of the unit and return water or air flows as described in sections 9.2 and 9.3 of ANSI/ASHRAE 103–82 and sections 3.2, 3.3, 3.4 and 3.5 of this appendix. The test unit shall be leveled prior to test. Operating times and beginning and end of condensate collection shall be determined by a clock or timer with a minimum resolution of one second. Humidity of the room air shall, at no time, exceed 80 percent.

Control of on or off operation actions shall be within ± 6 seconds of the scheduled time. Condensate drain lines shall be attached to the unit as specified in the manufacturer's installation instructions. A continuous downward slope of drain lines from the unit shall be maintained. Additional precautions shall be taken to facilitate uninterrupted flow of condensate during the test.

The flue pipe installation must not allow condensate formed in the flue pipe to flow back into the unit. An initial downward slope from the unit's exit, an offset with a drip leg, annular collection rings, or drain holes must be included in the flue pipe installation without disturbing normal flue gas flow, as specified in section 7.2.2 of ANSI/ASHRAE 103–82. Flue gases should not flow out of the drain with the condensate.

Collection-containers must be glass or polished stainless steel, so removal of interior deposits can be easily made. The collection-container shall have a vent opening to the atmosphere.

The scale for measuring the containers and sample condensate mass shall be calibrated with an error no larger than ± 0.5 percent over the range of interest.

The condensing furnace or boiler shall be tested by the flue loss method in accordance with the provisions for condensing units, as specified in section 9 of ANSI/ASHRAE 103–82 and section 3 of this appendix. The condensate collection-containers shall be dried prior to each use and shall be at room ambient temperature prior to a sample collection. Tare weight of the collection-container must be measured and recorded prior to each sample collection.

The unit should be operated in a cyclical manner until flue gas temperatures at the end of each on-cycle are within 5° F (2.8° C) of each other for two consecutive cycles. On-cycle and off-cycle times are listed in Table 2 of this appendix. Begin three test cycles. Return air temperature for furnaces shall be as specified in section 9 of ANSI/ASHRAE 103–82 and section 3 of this appendix. Return water temperature for boilers shall be as specified in section 2.3 of this appendix. Operation of the furnace blower or boiler pump shall conform to the time delay requirements specified in sections 9.2 and 9.3 of ANSI/ASHRAE 103–82 and sections 3.2, 3.3, 3.4, and 3.5 of this appendix for cool down and heat up tests. Operation of the boiler pump shall conform to the time delay requirements specified in section 3.3 of this appendix.

Begin condensate collection at one minute before the on-cycle period of the first test cycle. The container shall be removed one minute before the end of each off-cycle period of the sixth test cycle. Condensate mass shall be measured for each test cycle.

Fuel input shall be recorded during the entire test period starting at the beginning of the on-time period of the first cycle to the beginning of the on-time period of the second cycle, etc., for each of the test cycles. Fuel higher heating value (HHV), temperature and pressures necessary for determining fuel energy input (Q_c) shall be recorded. The fuel quantity and HHV shall be measured with errors no greater than one percent. Determine the mass of condensate for each cycle (m_c) in pounds. If at the end of three cycles, the sample standard deviation is within 20% of the mean value for 3 cycles use total condensate collected in the three cycles as m_c, if not, continue collection for an additional three cycles and use the total condensate collected for the six cycles as m_c. Determine the fuel energy input during the three or six test cycles (Q_c) expressed in Btu.

Begin a steady-state condensate collection after steady-state conditions have been achieved as specified in section 8 of ANSI/ASHRAE 103–82 and section 2 of this appendix. The steady-state collection period shall be 30 minutes. Condensate mass shall be measured immediately at the end of the collection period to prevent evaporation loss from the sample. Fuel input shall be recorded for the one hour steady-state test period. Fuel Higher Heating Value (HHV), temperature and pressures necessary for determining fuel energy input $Q_{C,ss}$ will be observed and recorded in Btu's. The fuel quantity and HHV shall be measured with errors no greater than one percent. Determine the mass of condensate for the steady-state test, $m_{C,ss}$ in pounds by subtracting the tare container weight from the total container and condensate weight measured at the end of the 30 minutes test period.

3.7 *Direct measurement of off-cycle losses testing method.* Reserved.

3.8 *Direct measurement of the S/F factors for oil furnaces and boilers.* For oil furnaces and boilers that are marketed and sold with attached barometric dampers, the

S/F factor shall be determined either by using assigned factors in Table 2 of ANSI/ASHRAE 103-82 or by the following test procedure:

To directly measure the S/F factor, seal the barometric damper plate in the closed position. Operate the furnace or boiler until steady-state temperatures are attained. Adjust the draft in the flue within one foot of the heat exchanger exit to be between 0.075 and 0.085 inch water column. A mechanical draft inducer or a natural draft developed by adjusting the height of the test stack may be used. Remove the seal from the barometric damper and adjust the damper gate to achieve proper draft, as specified by the manufacturer. If the draft over the fire is specified as a range, adjust the draft to the mid-point of that range.

After steady-state conditions are again achieved with the draft adjusted as specified, measure CO_2 before and after dilution at points marked A and B in Figure 2 of this appendix. To ensure that the sample is well mixed after dilution obtain a representative sample of stack gas by sampling from several points on a horizontal plane through the cross section of the stack. The test setup shown in Figure 2 enhances the mixing of dilution air and flue gases. Alternatively, a straight length of stack or other flue piping arrangement may be used with stack samples taken sufficiently downstream after dilution in order to obtain a well-mixed sample.

3.9 *Furnaces and boilers that includes small air passages in the flue.* For furnaces and boilers that includes small air passages in the flue where such passage serves a utility other than for draft relief, the air passage shall be open during all tests and the test data shall be reduced as specified in section 4 of this appendix.

These units shall be considered as direct exhaust systems, for the purposes of this test procedure. These provisions shall not apply to systems which allow for air flow through the air passage in excess of 10 percent of maximum steady state total flue flow; in these cases, such passages are to be considered as draft diverters or draft hoods.

4.0 *Calculations.* Calculations shall be as specified in section 11 of ANSI/ASHRAE 103-82 with the exception of section 11.2.6, and the inclusion of the following additional calculations:

4.1 *Annual fuel utilization efficiency for electric furnaces and boilers.* The annual fuel utilization efficiency for electric furnaces and boilers (AFUE) is equal to the heating seasonal efficiency for electric furnaces and boilers (Effy_{HS}) as defined in section 11.1 of ANSI/ASHRAE 103-82.

4.2. *Average ratio of stack gas mass flow rate to flue gas mass flow rate at steady-state operation.* The following paragraphs are in place of the requirements spec section 11.2.6 of ANSI/ASHRAE 103-

For gas furnaces and boilers with int draft diverters, calculate the average of stack gas mass flow rate to flue flow rate at steady-state operation (S/F) fined as:

$S/F=1.3\ R_{T,S}/R_{T,F}$

where:

$R_{T,S}$=as defined in 11.2.3 of ANSI/ASH 103-82

$R_{T,F}$=as defined in 11.2.2 of ANSI/ASH 103-82

For gas furnaces and boilers equ with draft hoods determine the S/F by method set out above or use the ass value of 2.4. This alternative method be used until 24 months from the effe date of the amendment. After that date, assigned value may not be used and only method set out above may be used.

For oil furnaces and boilers, S/F shall 1.40 for units not shipped with barom dampers or for units shipped with barom ric dampers, S/F shall be either 1.40 or termined by:

$S/F=R_{T,S}/R_{T,F}$

where:

$R_{T,S}$=as defined in 11.2.3 of ANSI/ASHR 103-82 in which the value of CO_2 me ured in the stack in 3.8 of this appe is used

$R_{T,F}$=as defined in 11.2.2 of ANSI/ASHR 103-82 in which the value of CO_2 me ured in the flue in 3.8 of this append used

4.3 *Optional direct condensate meas ment method.* For condensing furnaces boilers for which the direct measurement condensate is used, as specified in sect 3.6 of this appendix, calculate the part-l efficiency (η_u) and the steady-state effic cy (η_{ss}) expressed as a percent and def as:

$\eta_u=\text{Effy}_{hs}+L_G-L_C$

$\eta_{ss}=\text{Effy}_{ss}+L_{G,ss}-L_{C,ss}$

where:

Effy_{hs}=heating seasonal efficiency for condensing furnaces and boilers, as fined in 11.2.34 of ANSI/ASHRAE 82

L_G=latent heat gain under part-load co tions, as defined in 4.3.1 of this app

L_C=part-load heat loss due to the con sate going down the drain and corre for the fact that the condensate did go up the flue as heated vapor, as assumed in determining $L_{G,ss,A}$, as fined in 4.3.2 of this appendix

Effy_{ss}=steady-state efficiency for non denaing furnaces and boilers, as def in 11.2.5 of ANSI/ASHRAE 103-82

$L_{G,SS}$=latent heat gain under steady-state conditions, as defined in 4.3.3 of this appendix

$L_{C,SS}$=steady-state heat loss due to the condensate going down the drain and corrected for the fact that the condensate did not go up the flue as heated vapor, as was assumed in determining $L_{L,A}$, as defined in 4.3.4 of this appendix

4.3.1 *Latent heat gain under part-load conditions.* Calculate the latent heat gain under part-load conditions (L_G) expressed as a percent and defined as:

$L_G = 100(1053.3)\ m_c/Q_c$

where:

100=conversion factor to express a decimal as a percent

1053.3=latent heat vaporization of water, Btu per pound

m_c=as defined in 3.6 of this appendix

Q_c=as defined in 3.6 of this appendix

4.3.2 *Part-load heat loss due to the condensate.* Calculate the part-load heat loss due to the condensate going down the drain and corrected for the fact that the condensate did not go up the flue as heated vapor, as was assumed in determining $L_{L,A}$ (L_C) expressed as a percent and defined as:

$L_C = L_G[1.0(T_{F,SS} - 70) - 0.45(T_{F,SS} - 42)]/1053.3$

where:

L_G=as defined in 4.3.1 of this appendix

1.0=specific heat of water (liquid), Btu per pound − °F

$T_{F,SS}$=as defined in 11.2.4 of ANSI/ASHRAE 103-82

70=assumed average indoor air temperature, °F

0.45=specific heat of water vapor, Btu per pound − °F

42=average outdoor temperature corresponding to 5,200 degree day location, °F

1053.3−Latent heat of vaporization of water, Btu per pound

4.3.3 *Latent heat gain under steady-state conditions.* Calculate the latent heat gain under steady-state conditions ($L_{G,SS}$) expressed as a percent and defined as:

$L_{G,SS} = 100(1053.3)m_{C,SS}/Q_{C,SS}$

where:

100=conversion factor to express a decimal as a percent

1053.3=latent heat of vaporization of water, Btu per pound

$m_{C,SS}$=as defined in 3.6 of this appendix, pound

$Q_{C,SS}$=as defined in 3.6 of this appendix, Btu

4.3.4 *Steady-state heat loss due to the condensate.* Calculate the steady-state heat loss due to the condensate going down the drain ($L_{C,SS}$) expressed as a percent and defined as:

$L_{C,SS} = L_{G,SS}[1.0(T_{F,SS} - 70) - 0.45(T_{F,SS} - 42)]/1053.3$

where:

$L_{G,SS}$=as defined in 4.3.3 of this appendix

1.0=specific heat of water (liquid), Btu per pound − °F

$T_{F,SS}$=as defined in 11.2.4 of ANSI/ASHRAE 103-82

70=assumed average indoor air temperature, °F

0.45=specific heat of water vapor, Btu per pound − °F

42=average outdoor temperature corresponding to 5200 degree day location, °F

1053.3=latent heat of vaporization of water, Btu per pound

4.4 *Direct determination of off-cycle losses for furnaces and boilers equipped with stack dampers.* Reserved

4.5 *Modulating controls.*

4.5.1 *Weighted-average part-load utilization efficiency.* For furnaces and boilers equipped with two stage thermostats, calculate the weighted-average part-load utilization efficiency at each design heating requirement ($\eta_{U,WT}$) expressed as a percent and defined as:

$\eta_{U,WT} = X_1\eta_{U,RED} + X_2\eta_{U,MAX}$

where:

X_1=fraction of heating load at reduced operating mode, as defined in 4.5.2 of this appendix

$\eta_{U,RED}$=the part-load efficiency at the reduced fuel input rate and is defined as the heating seasonal efficiency ($Effy_{HS}$) in 11.2.34 of ANSI/ASHRAE 103-82, measured at the reduced fuel input rate and calculated by using the appropriate on and off times as specified from Table 2 of this appendix

X_2=fraction of heating load at maximum operating mode, as defined in 4.5.3 of this appendix

$\eta_{U,MAX}$=the part-load efficiency at the maximum fuel input rate and is defined as the heating seasonal efficiency ($Effy_{HS}$) in 11.2.34 of ANSI/ASHRAE 103-82, measured at the maximum fuel input rate and calculated by using the appropriate on and off times as specified from Table 2 of this appendix

For furnaces and boilers equipped with step-modulating thermostats, calculate $\eta_{U,WT}$ expressed as a percent and defined as:

$\eta_{U,WT} = X_1\ \eta_{U,RED} + X_2\eta_{U,MOD}$

where:

X_1=as defined in 4.5.2 of this appendix

$\eta_{U,RED}$=as defined in 4.5.1 of this appendix

X_2=as defined in 4.5.3 of this appendix

$\eta_{U,MOD}$=average part-load efficiency for the modulating mode, as defined in 4.5.8 of this appendix

4.5.2 *Fraction of heating load at reduced operating mode.* Determine the fraction of heating load at the reduced operating mode (X_1) expressed as a decimal and listed in either Figure 4 or Table 3 of this appendix for appropriate values of the balance point temperature (T_C). T_C is defined in section 4.5.4 of this appendix.

4.5.3 *Fraction of heating load at maximum operating mode.* Determine the fraction of heating load at the maximum operating mode (X_2) expressed as a decimal and listed in either Figure 4 or Table 3 of this appendix for appropriate values of the balance point temperature (T_C).

4.5.4 *Balance point temperature.* Calculate the balance point temperature (T_C) which represents a temperature used to apportion the annual heating load between the reduced input cycling mode and either the modulation mode or maximum input cycling mode. T_C is defined as:

$T_C=65-[\Delta T_D(1+\alpha_{DHR})][Q_{OUT,RED}/Q_{OUT,MAX}]]$

where:

65=average outdoor temperature at which a furnace or boiler starts operating, °F

ΔT_D=the difference between the outdoor air temperature where heating is typically required and the outdoor design temperature, the national average temperature difference is 65° F−5° F or 60° F

5=outdoor design temperature

α_{DHR}=oversize factor at each design heating requirement, as defined in 4.5.5 of this appendix

$Q_{OUT,RED}$=heat output rate at the reduced fuel input rate, as defined in 4.5.6 of this appendix

$Q_{OUT,MAX}$=heat output rate at the maximum fuel input rate, as defined in 4.5.7 of this appendix

4.5.5 *Oversize factor at each design heating requirement.* Calculate the oversize factor at each design heating requirement (α_{DHR}) expressed as a decimal and defined as:

$\alpha_{DHR}=[Q_{OUT,MAX}/DHR]-1$

where:

$Q_{OUT,MAX}$=as defined in 4.5.7 of this appendix

DHR=typical design heating requirements, as listed in Table 1 of this appendix

4.5.6 *Heat output rate at the reduced fuel input rate.* Calculate the heat output rate at the reduced fuel input rate ($Q_{OUT,RED}$) defined as:

$Q_{OUT,RED}=\eta_{SS,RED}Q_{IN,RED}$

where:

$\eta_{SS,RED}$=steady-state efficiency at the reduced fuel input rate and is defined as the steady-state efficiency ($Effy_{ss}$) in 11.2.5 of ANSI/ASHRAE 103-82, measured at the reduced fuel input rate

$Q_{IN,RED}$=the reduced fuel input rate and is defined as Q_{IN} in 11.2.34 of ANSI/ASHRAE 103-82, measured at the reduced fuel input rate

4.5.7 *Heat output rate at the maximum fuel input rate.* Calculate the heat output rate at the maximum fuel input rate ($Q_{OUT,MAX}$) defined as:

$Q_{OUT,MAX}=\eta_{SS,MAX}Q_{IN,MAX}$

where:

$\eta_{SS,MAX}$=steady-state efficiency at the maximum fuel input rate and is defined as the steady-state efficiency ($Effy_{ss}$) in 11.2.5 of ANSI/ASHRAE 103-82, measured at the maximum fuel input rate

$Q_{IN,MAX}$=the maximum fuel input rate and is defined as $_{IN}$ in 11.2.34 of ANSI/ASHRAE 103-82

4.5.8 *Average part-load efficiency for the modulating mode for furnaces and boilers equipped with step-modulating thermostats.* For furnaces and boilers equipped with step-modulating thermostats and are located in heated spaces, calculate the average part-load efficiency for the modulating mode ($\eta_{U,MOD}$) expressed as a percent and defined as:

$\eta_{U,MOD}=\eta_{SS,MOD}-L_{S,ON,MOD}$

where:

$\eta_{SS,MOD}$=average steady-state efficiency for the modulating mode as defined in 4.5.9 of this appendix

$L_{S,ON,MOD}$=average on-cycle infiltration heat loss for the modulating mode as defined in 4.5.10 of this appendix

For furnaces and boilers equipped with step-modulating thermostats and are located outside or are in unheated spaces, calculate $\eta_{U,MOD}$ defined as:

$\eta_{U,MOD}=\eta_{SS,MOD}-C_jL_j$

where:

$\eta_{SS,MOD}$=as defined in 4.5.9 of this appendix

C_j=as defined in 4.6 of this appendix

L_j=as defined in 4.6 of this appendix

4.5.9 *Average steady-state efficiency for the modulating mode for furnaces and boilers equipped with step-modulating thermostats.* For furnaces and boilers equipped with step-modulating thermostats, calculate the average steady-state efficiency for the modulating mode ($\eta_{SS,MOD}$) expressed as a percent and defined as:

$$\eta_{SS\text{-}MOD}=\left[\frac{DHR-Q_{OUT,RED}}{Q_{OUT,MAX}-Q_{OUT,RED}}\right]\left[\frac{T_C-T_{OA^*}}{T_C-5}\right]\left[\eta_{SS,MAX}-\eta_{SS,RED}\right]+\eta_{SS,RED}$$

where:

DHR = average design heating requirement as listed in Table 1 of this appendix

$Q_{OUT,RED}$ = as defined in 4.5.6 of this appendix

$Q_{OUT,MAX}$ = as defined in 4.5.7 of this appendix

T_C = as defined in 4.5.4 of this appendix and is based on the average design heating requirement listed in Table 3 of this appendix

T_{OA^*} = average outdoor air temperature during the modulating mode, as defined in 4.5.1 of this appendix and is based on the average design heating requirement listed in Table 3 of this appendix

5 = outdoor design temperature, °F

$\eta_{SS,MAX}$ = as defined in 4.5.7 of this appendix

$\eta_{SS,RED}$ = as defined in 4.5.6 of this appendix

4.5.10 *Average on-cycle infiltration heat loss for the modulating mode for furnaces and boilers equipped with step-modulating thermostats.* For furnaces and boilers equipped with step-modulating thermostats, calculate the average on-cycle infiltration heat loss for the modulating mode ($L_{I,ON,MOD}$) expressed as a percent and defined as:

$L_{I,ON,MOD}=[K_{I,ON,RED}(70-T_{OA})+K_{I,ON,MAX}(70-T_{OA^*})]/2$

where:

$K_{I,ON,RED}$ = multiplication factor for infiltration loss during burner on-cycle at the reduced firing rate, and defined as $K_{I,ON}$ in 11.2.18 of ANSI/ASHRAE 103-82 at the reduced firing rate

70 = average indoor temperature, °F

T_{OA} = average outdoor temperature in the cycling mode, based on the average design heating requirement, and is listed in either Figure 3 or Table 2 of this appendix

$K_{I,ON,MAX}$ = multiplication factor for infiltration loss during burner on-cycle at the maximum firing rate, and defined as $K_{I,ON}$ in 11.2.18 of ANSI/ASHRAE 103-82 at the maximum firing rate

T_{OA^*} = average outdoor temperature in the modulating mode, based on the average design heating requirement, and is listed in either Figure 3 or Table 3 of this appendix

4.5.11 *Average heat output rate for the modulating mode for furnaces and boilers equipped with step-modulating thermostats.* For furnaces and boilers equipped with step-modulating thermostats, calculate the average heat output rate for the modulating mode ($Q_{OUT,MOD}$) defined as:

$Q_{OUT,MOD}=[[DHR-Q_{OUT,RED}][T_C-T_{OA^*}]/[T_C-5]]+Q_{OUT,RED}$

where:

DHR = average design heating requirement, as listed in Table 1 of this appendix

$Q_{OUT,RED}$ = as defined in 4.5.6 of this appendix

T_C = as defined in 4.5.4 of this appendix and is based on the average design heating requirement listed in Table 3 of this appendix

T_{OA^*} = as defined in 4.5.10 of this appendix and is based on the average design heating requirement listed in Table 3 of this appendix

5 = outdoor design temperature; °F

4.5.12 *Average fuel input rate for the modulating mode for furnaces and boilers equipped with step-modulating thermostats.* For furnaces and boilers equipped with step-modulating thermostats, calculate the average fuel input rate for the modulating mode ($Q_{IN,MOD}$) defined as:

$Q_{IN,MOD}=Q_{OUT,MOD}/\eta_{SS,MOD}$

where:

$Q_{OUT,MOD}$ = as defined in 4.5.11 of this appendix

$\eta_{SS,MOD}$ = as defined in 4.5.9 of this appendix

4.5.13 *Average outdoor temperature.* For furnaces and boilers equipped with two stage thermostats or with step-modulating thermostats operating at the reduced operating mode, the average outdoor temperature shall be T_{OA}, as obtained either from Figure 3 or Table 3 of this appendix. For furnaces and boilers equipped with two stage thermostats operating at the maximum operating mode or with step-modulating thermostats operating at the modulating mode, the average outdoor temperature shall be T_{OA^*}, as obtained from either Figure 3 or Table 3 of this appendix. These values for the average outdoor temperature shall replace the value of 42 specified as the average outdoor temperature in sections 11.2.15, 11.2.17, 11.2.19, 11.2.30, 11.2.31, and 11.2.33 of ANSI/ASHRAE 103–82.

4.5.14 *Weighted-average steady-state efficiency.* For furnaces and boilers equipped with two stage thermostats, calculate the weighted-average steady-state efficiency ($\eta_{SS,WT}$) expressed as a percent and defined as:

$\eta_{SS,WT}=X_H\eta_{SS,MAX}+X_L\eta_{SS,RED}$

where:

X_L = as defined in 4.5.2 of this appendix

$\eta_{SS\text{-}MAX}$ = as defined in 4.5.7 of this appendix
X_2 = as defined in 4.5.3 of this appendix
$\eta_{SS\text{-}RED}$ = as defined in 4.5.6 of this appendix

For furnaces and boilers equipped with step-modulating thermostats, calculate $\eta_{SS\text{-}WT}$ defined as:

$\eta_{SS\text{-}WT} = X_2 \eta_{SS\text{-}MOD} + X_1 \eta_{SS\text{-}RED}$

where:

X_1 = as defined in 4.5.2 of this appendix
$\eta_{SS\text{-}MOD}$ = as defined in 4.5.9 of this appendi
X_2 = as defined in 4.5.3 of this appendix
$\eta_{SS\text{-}RED}$ = as defined in 4.5.6 of this appendi

4.6 *Annual fuel utilization efficien* The annual fuel utilization efficien (AFUE) shall be expressed as a percent a defined as:

$$AFUE = \frac{5200 N_m N_s Q_{in}}{5200 N_m Q_{in} + \frac{2.5(1+0.7)(4600)}{N_s Q_p}}$$

where:

5200 = average annual heating degree-days

N_m = as defined in 4.3 of this appendix for condensing furnaces and boilers measured by the optional direct condensate measurement method; as $N_{SS\text{-}WT}$ as defined in 4.5.14 of this appendix at each design heating requirement for modulating furnaces and boilers; or as $Effy_{SS}$ as defined in 11.2.5 of ANSI/ASHRAE 103-82 for all other furnaces and boilers.

N_s = part load efficiency and is based on the assumption that all weatherized warm air furnaces or boilers are located out-of-doors; warm air furnaces which are not weatherized are installed as isolated combustion systems; and boilers which are not weatherized are installed in doors. Part load efficiency as defined in 4.3 of this appendix for condensing furnaces and boilers measured by the optional direct condensate measurement method; as $N_{s,wt}$ as defined in 4.5.1 of this appendix at each design heating requirement for modulating furnaces and boilers; or as $Effy_{HS}$ as defined in 11.2.34 of ANSI/ASHRAE 103-82 and in 4.2 of this appendix for all other furnaces and boilers except that C_j and L_j are defined as:

0 for boilers which are not weatherized
3.3 for furnaces which are weatherized
C_j = 1.7 for furnaces which are not weatherized
4.7 for boilers which are weatherized

L_j = jacket loss and is either assigned the value of 1 percent or determined in accordance with 8.6 of ANSI/ASHRAE 103-82 in percent

Q_{in} = steady-state heat input as defined in 11.2.34 of NSI/ASHRAE 103-82

0.7 = average oversizing factor for furnaces and boilers

4600 = average non-heating season hours per year

Q_p = pilot flame fuel input rate as defined in 9.2 of of ANSI/ASHRAE 103-82

4.7 *National average number of burner operating hours.* For furnaces and boilers equipped with single stage thermostats, c culate the national average number burner operating hours (BOH_{SS}) defined

BOH_{SS} = 2080(0.77)A DHR-2080 B

where:

2080 = national average heating load hour
0.77 = adjustment factor which serves adjust the calculated design heating quirement and heating load hours to t actual heating load experienced by heating system
DHR = typical design heating requireme as listed in Table 1 of this appen using the proper value of Q_{OUT} where
$Q_{OUT} = (\eta_{SS}/100-(K)\ (L_j)/100)\ (Q_{in})$ round off to the nearest 1,000 Btu/hr

where:

η_{SS} as defined in 4.3 of this appendix for co densing furnaces and boilers measur by the optional direct condensate mea urement method: as $\eta_{SS\text{-}WT}$ as defined 4.5.14 of this appendix at each de heating requirement for modulating fu naces and boilers; or as $Effy_{SS}$ as defi in 11.2.5 of ANSI/ASHRAE 103-82 f all other furnaces and boilers.
Q_{in} as defined in 11.2.34 of ANSI/ASHR 103-82
K = factor that adjusts jacket losses me ured in the laboratory to those th would be measured under outdo design conditions.
0 for boilers which are not weatherized.
1.7 for furnaces which are not weatheriz
3.3 for furnaces or boilers which are wea erized.
1.0 for finned tubed boilers which a weatherized
L_j = jacket loss
$A = 100{,}000/[341{,}300(PE+y\ BE)+(Q_{in}-Q_p)$
$B = 2\ Q_p \eta_U A/100{,}000$
100,000 = factor that accounts for perc and kBtu
PE = power burner electrical energy inp rate at full-load steady-state operati as defined in 9.1 of ANSI/ASHRAE 10 82

ratio of average blower or pump on time to average burner on time

1, for furnaces without a fan delay

y= 1, for boilers without a pump delay

1 + $(t^+ - t^-)/3.87$, for single stage furnaces with fan delay

1 + $(t^+ - t^-)/10.00$, for two stage and step modulating furnaces with fan delay

1 + $(t^+/9.68)$, for single stage boilers with pump delay

1 + $(t^+/15.00)$, for two stage and step modulating boilers with pump delay

BE=circulating air fan (or circulating water pump) electrical energy input rate at full-load steady-state operation, as defined in 9.1 of ANSI/ASHRAE 103–82
Q_{IN}=as defined in 11.2.34 of ANSI/ASHRAE 103–82
Q_P=as defined in 11.2.34 of ANSI/ASHRAE 103–82
η_U=as defined in 4.6 of this appendix
2=ratio of the average length of a heating season in hours to the average heating load hours
t^+=as defined in 3.3 of this appendix
t^-=as defined in 9.3.1 of ANSI/ASHRAE 103–82

For furnaces and boilers equipped with two stage thermostats or step-modulating thermostats, calculate the national average number of burner operating hours at the reduced operating mode (BOH_{RED}) defined as:

$BOH_{RED}=X_1 E_M/Q_{IN,RED}$

where:

X^1=as defined in 4.5.2 of this appendix
E_M=average annual energy used during the heating season
$E_M=(Q_{IN,MAX}-Q_P)BOH_{SS}+(8760-4600)Q_P$
$Q_{IN,RED}$=as defined in 4.5.6 of this appendix
$Q_{IN,MAX}$=as defined in 4.5.7 of this appendix
Q_P=as defined in 11.2.34 of ANSI/ASHRAE 103-82
BOH_{SS}=as defined in 4.7 of this appendix in which $\eta_{U,WT}$ replaces η_U for calculating the values of A and B and the term (PE + y BE) in the factor A is increased by the ratio, R. It is defined as:

2.3 for two stage controls

2.3 for step-modulating controls when the ratio of minimum-to-maximum output is greater than or equal to 0.5

R= 3.0 for step modulating controls when the ratio of minimum-to-maximum out is less than 0.5

$A=100{,}000/[341{,}300(PE + y\ BE)R + (Q_{IN}-Q_P)\eta_U]$
8760=total number of hours per year
4600=as defined in 4.6 of this appendix

For furnaces and boilers equipped with two stage thermostats, calculate the national average number of burner operating hours at the maximum operating mode (BOH_{MAX}) defined as:

$BOH_{MAX}=X_2 E_M/Q_{IN,MAX}$

where:

X_2=as defined in 4.5.3 of this appendix
E_M=as defined in 4.7 of this appendix
$Q_{IN,MAX}$=as defined in 4.5.7 of this appendix

For furnaces and boilers equipped with step-modulating thermostats, calculate the national average number of burner operating hours in the modulating mode (BOH_{MOD}) defined as:

$BOH_{MOD}=X_2 E_M/Q_{IN,MOD}$

where:

X_2=as defined in 4.5.3 of this appendix
E_M=as defined in 4.7 of this appendix
$Q_{IN,MOD}$=as defined in 4.5.12 of this appendix

4.8 *Average annual fuel energy consumption for gas or oil fueled furnaces or boilers.* For furnaces and boilers equipped with single stage thermostats, calculate the average annual fuel energy consumption for gas or oil fueled furnaces or boilers (E_F) expressed in Btu's per year and defined as:

$E_F=BOH(Q_{IN}-Q_P)+8760\ Q_P$

where:

BOH=as defined in 4.7 of this appendix
Q_{IN}=as defined in 11.2.34 of ANSI/ASHRAE 103–82
Q_P=as defined in 11.2.34 of ANSI/ASHRAE 103–82
8760=as defined in 4.7 of this appendix

For furnaces and boilers equipped with either two stage thermostats or step-modulating thermostats, calculate E_F as defined as:

$E_F=E_M+4600\ Q_P$

where:

E_M=as defined in 4.7 of this appendix
4600=as defined in 4.6 of this appendix
Q_P=as defined in 11.2.34 of ANSI/ASHRAE 103–82

4.9 *Average annual auxiliary electrical energy consumption for gas or oil fueled furnaces or boilers.* For furnaces and boilers equipped with single stage thermostats, calculate the average annual auxiliary electrical energy consumption (E_{AE}) expressed in kilowatt-hours per year and defined as:

$E_{AE}=BOH_{SS}\,(PE+y\;BE)$

where:

BOH_{SS}=as defined in 4.7 of this appendix
PE=as defined in 9.1 of ANSI/ASHRAE 103-82
y=as defined in 4.7 of this appendix
BE=as defined in 9.1 of ANSI/ASHRAE 103-82

For furnaces and boilers equipped with two stage thermostats, calculate E_{AE} defined as:

$E_{AE}=BOH_{RED}\;(PE_{RED}+y\;BE_{RED})+BOH_{MAX}(PE_{MAX}+y\;BE_{MAX})$

where:

BOH_{RED}=as defined in 4.7 of this appendix
PE_{RED}=as defined in 9.1 of ANSI/ASHRAE 103-82, measured at the reduced fuel input rate
y=as defined in 4.7 of this appendix
BE_{RED}=as defined in 9.1 of ANSI/ASHRAE 103-82, measured at the reduced fuel input rate
BOH_{MAX}=as defined in 4.7 of this appendix
PE_{MAX}=as defined in 9.1 of ANSI/ASHRAE 103-82, measured at the maximum fuel input rate
BE_{MAX}=as defined in 9.1 of ANSI/ASHRAE 103-82, measured at the maximum fuel input rate

For furnaces and boilers equipped with step-modulating thermostats, calculate E_{AE} defined as:

$E_{AE}=BOH_{RED}\;(PE_{RED}+y\;BE_{RED})+BOH_{MOD}(PE_{MAX}+y\;BE_{MAX})$

where:

BOH_{RED}=as defined in 4.7 of this appendix
PE_{RED}=as defined in 4.9 of this appendix
y=as defined in 4.7 of this appendix
BE_{RED}=as defined in 4.9 of this appendix
BOH_{MOD}=as defined in 4.7 of this appendix
PE_{MAX}=as defined in 4.9 of this appendix
BE_{MAX}=as defined in 4.9 of this appendix

4.10 *Average annual electric energy consumption for electric furnaces or boilers.* For electric furnaces and boilers, calculate the average annual electric energy consumption (E_E) expressed in kilowatt-hours per year and defined as:

$E_E=100(2080)(0.77)\;DHR/3.412\;AFUE$

where:

100=conversion to express a percent as a decimal
2080=as defined in 4.7 of this appendix
0.77=as defined in 4.7 of this appendix
DHR=as defined in 4.7 of this appendix
3.412=conversion to express energy in terms of watt-hours instead of Btu
AFUE=as defined in 4.1 of this appendix

4.11 *Average annual fuel energy consumption for gas or oil fueled furnaces or boilers located in different geographic regions of the United States and in buildings with different design heating requirem* For gas or oil fueled furnaces and boil calculate the average annual fuel ener consumption for a specific geograph region and for a specific typical design hea ing requirement (E_{FR}) expressed in Btu's p year and defined as:

$E_{FR}=[(E_F-8760\;Q_P)HLH/2080]+8760\;Q$

where:

E_F=as defined in 4.8 of this appendix
8760=as defined in 4.7 of this appendix
Q_P=as defined in 11.2.34 of ANSI/ASHR 103-82
HLH=heating load hours for a specific ge graphic region determined in accordan with the heating load hour map Figure 1 of this appendix
2080=as defined in 4.7 of this appendix

4.12 *Average annual auxiliary electri energy consumption for gas or oil fueled fu naces or boilers located in different ge graphic regions of the United States and buildings with different design heating quirements.* For gas or oil fueled furnac and boilers, calculate the average annu auxiliary electrical energy consumption f a specific geographic region and for a speci ic typical design heating requirement (E expressed in kilowatt-hours per year and fined as:

$E_{AER}=E_{AE}HLH/2080$

where:

E_{AE}=as defined in 4.9 of this appendix
HLH=as defined in 4.11 of this appendix
2080=as defined in 4.7 of this appendix

4.13 *Average annual electric energy co sumption for electric furnaces or boilers cated in different geographic regions of United States and in buildings with diffe ent design heating requirements.* For ele tric furnaces and boilers, calculate the ave age annual electric energy consumption a specific geographic region and for a speci ic typical design heating requirement (E expressed in kilowatt-hours per year and fined as:

$E_{ER}=100(0.77)DHR\;HLH/3.412\;AFUE$

where:

100=as defined in 4.10 of this appendix
0.77=as defined in 4.7 of this appendix
DHR=as defined in 4.7 of this appendix
HLH=as defined in 4.11 of this appendix
3.412=as defined in 4.10 of this appendix
AFUE=as defined in 4.1 of this appendix

4.14 *Energy factor.* For electric furna and boilers, the energy factor (EF) is equ to AFUE, as defined in section 4.1 of this a pendix. For gas and oil furnaces and boile calculate EF as defined as:

$EF=\eta_U[E_F-4600\;Q_P]/[E_F+3412\;E_{AE}]$

where:

η_U=as defined in 4.6 of this appendix
E_F=as defined in 4.8 of this appendix
4600=as defined in 4.6 of this appendix
Q_P=as defined in 11.2.34 of ANSI/ASHRAE 103-82
3142=as defined in 4.10 of this appendix
E_{ae}=as defined in 4.9 of this appendix

TABLE 1—AVERAGE AND TYPICAL DESIGN HEATING REQUIREMENTS FOR FURNACES AND BOILERS WITH DIFFERENT OUTPUT CAPACITIES

Furnace or boiler output capacity, Q_{out} (Btu/hr)	Average design heating requirements (KBtu/hr)	Typical design heating requirements (KBtu/hr)
5,000–10,000	5	5
11,000–16,000	10	5, 10
17,000–25,000	15	10, 15
26,000–34,000	20	15, 20
35,000–42,000	25	20, 25, 30
43,000–51,000	30	25, 30, 35
52,000–59,000	35	30, 35, 40, 45
60,000–76,000	40	35, 40, 45, 50
77,000–93,000	50	40, 45, 50, 60
94,000–110,000	60	50, 60, 70, 80
111,000–127,000	70	60, 70, 80, 90
128,000–144,000	80	70, 80, 90, 100
145,000–161,000	90	80, 90, 100, 110, 120
162,000–178,000	100	90, 100, 110, 120, 130
179,000–195,000	110	100, 110, 120, 130, 140
over 196,000	130	120, 130, 140, 150, 160

TABLE 2—AVERAGE BURNER ON-TIME AND OFF-TIME PER CYCLE FOR FURNACES AND BOILERS (MINUTES)

Thermostat type	Furnaces		Boilers	
	t_{on}	t_{off}	t_{on}	t_{off}
Single stage	3.87	13.3	9.68	33.26
Two stage	10.0	10.0	15.0	15.0

TABLE 2—AVERAGE BURNER ON-TIME AND OFF-TIME PER CYCLE FOR FURNACES AND BOILERS (MINUTES)—Continued

Thermostat type	Furnaces		Boilers	
	t_{on}	t_{off}	t_{on}	t_{off}
Step modulating	10.0	10.0	15.0	15.0

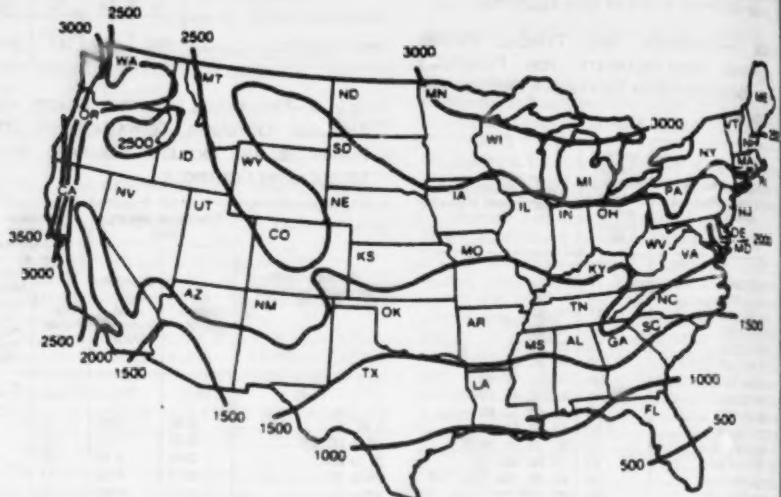
TABLE 3—FRACTIONAL HEATING LOADS AND AVERAGE OUTDOOR TEMPERATURES FOR FURNACES AND BOILERS EQUIPPED WITH MODULATING CONTROLS

Balance point temperature range (° F)	Fractional heating load		Average outdoor temperature (° F)	
	Reduced rate	Modulating or maximum rate	Reduced rate	Modulating or maximum rate
(T_C)	(X_1)	(X_2)	(T_{oa})	(T_{oa*})
6 to 15	0.95	0.05	41	9
16 to 20	0.90	0.10	42	14
21 to 25	0.84	0.16	43	18
26 to 28	0.77	0.23	44	22
29 to 31	0.70	0.30	45	24
32 to 33	0.66	0.34	46	26
34 to 35	0.60	0.40	47	27
36 to 37	0.54	0.46	48	28
38 to 39	0.48	0.52	48	30
40 to 41	0.42	0.58	49	31
42 to 43	0.35	0.65	50	32
44 to 45	0.29	0.71	51	33
46 to 47	0.23	0.77	52	35
48 to 49	0.18	0.82	54	36
50 to 52	0.12	0.88	55	37
53 to 57	0.07	0.93	56	39
58 to 62	0.02	0.98	61	40

NOTE.—This table is based on national average 5,200 degree-days.

FIGURE I

Heating Load Hours (HLH) for the United States and Territories


3000
2500
2500
3000
WA
MT
ND
MN
OR
2500
ID
WY
SD
WI
MI
3000
VT
NH
NY
MA
CA
NV
UT
NE
IA
IL
IN
OH
PA
NJ
3500
3000
CO
KS
MO
WV
VA
DE
MD
2000
KY
AZ
NM
OK
AR
TN
NC
SC
1500
2500
2000
1500
MS
AL
GA
TX
LA
1000
1500
1500
FL
500
1000
500

This map is reasonably accurate for most parts of the United States but is necessarily highly generalized and consequently not too accurate in mountainous regions, particularly in the Rockies.

Alaska — 3500 HLH

Hawaii and Territories — O HLH

FIGURE 2

Test Setup for Measuring S/F for Furnaces and Boilers with Barometric Draft Controls

Note: Dimensions are suggested minimums in inches and may be varied to assure well-mixed samples of gases.

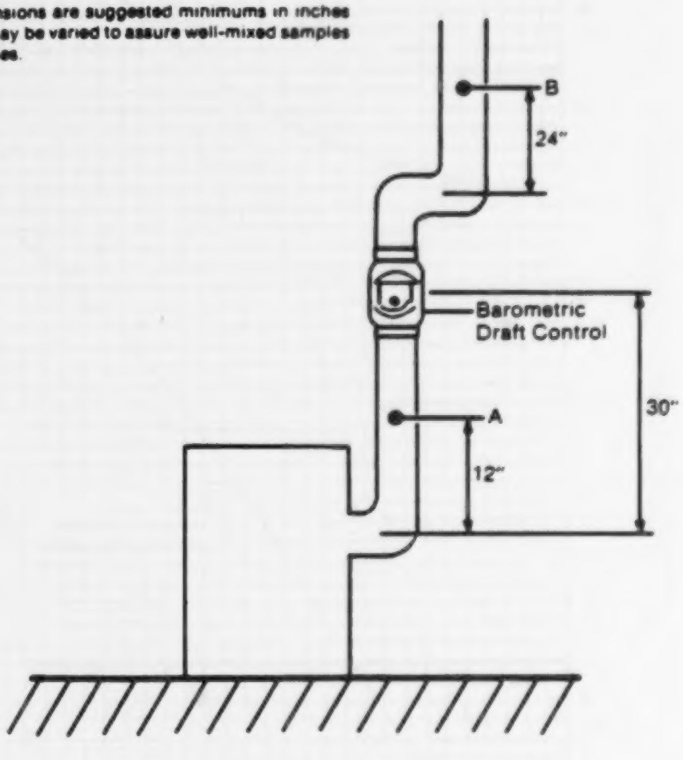
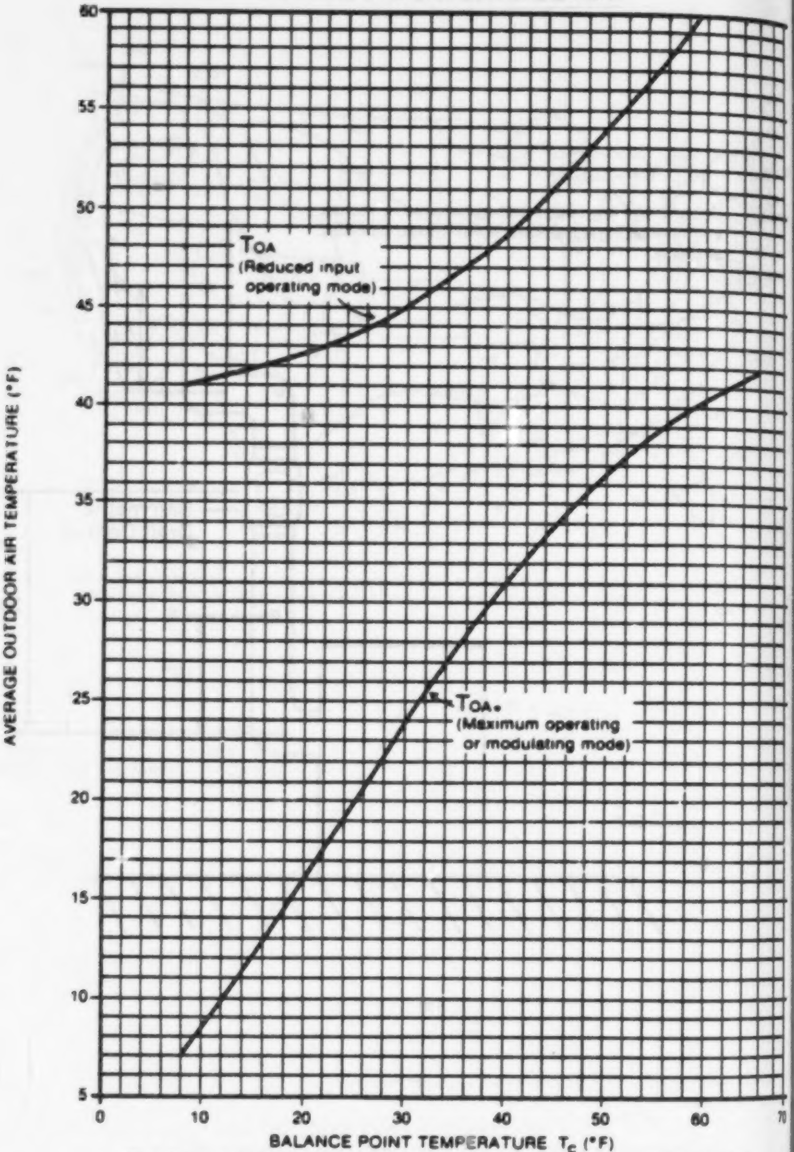

B
24"
Barometric Draft Control
30"
A
12"

FIGURE 3

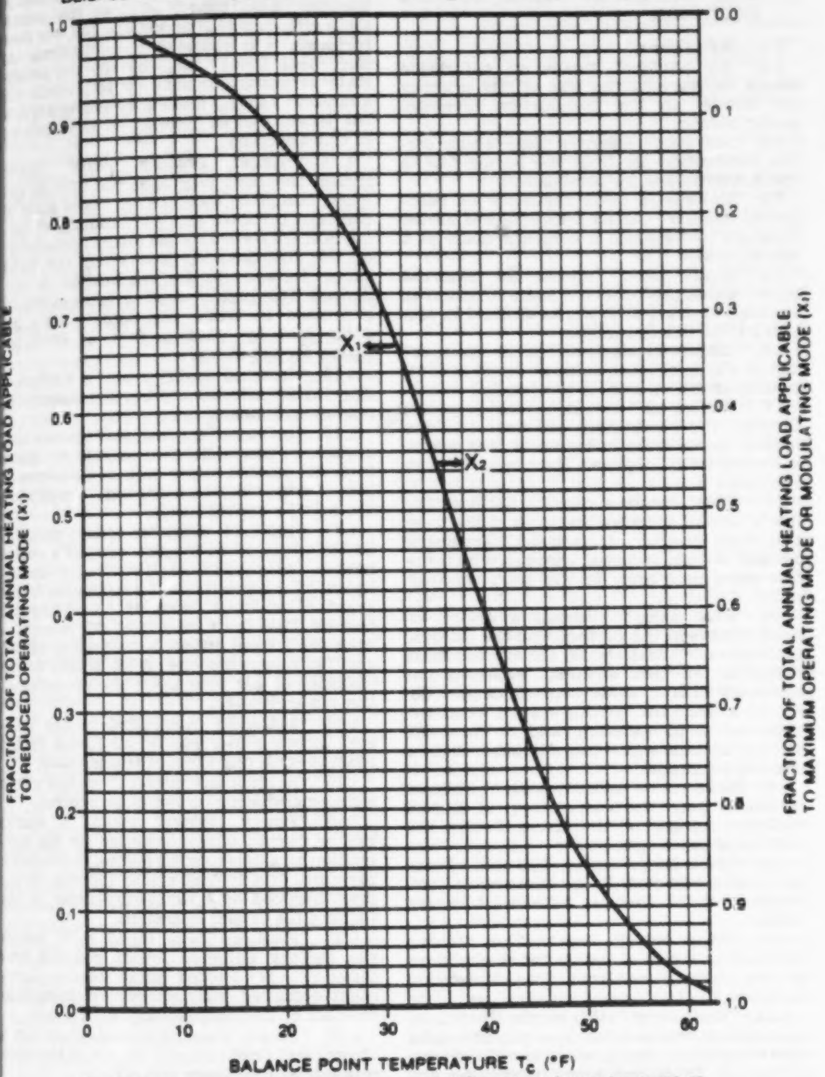
Average Outdoor Air Temperature vs. Balance Point Temperature for Modulating Furnaces and Boilers



This figure is based on 5200 degree-days and 5°F outdoor design temperature.

FIGURE 4

Fraction of Total Annual Heating Load Applicable to Reduced Operating Mode (X_1) and to Maximum Operating Mode or Modulating Mode (X_2) vs. Balance Point Temperature for Modulating Furnaces and Boilers.



This figure is based on 5200 degree-days and 5°F outdoor design temperature.

[49 FR 12159, Mar. 28, 1984, as amemded at 54 FR 6076, Feb. 7, 1989; 64 FR 11320, Mar. 17, 1999]

APPENDIX O TO SUBPART B OF PART 430—UNIFORM TEST METHOD FOR MEASURING THE ENERGY CONSUMPTION OF VENTED HOME HEATING EQUIPMENT

1.0 *Definitions.*

1.1 "Air shutter" means an adjustable device for varying the size of the primary air inlet(s) to the combustion chamber power burner.

1.2 "Air tube" means a tube which carries combustion air from the burner fan to the burner nozzle for combustion.

1.3 "Barometic draft regulator or barometric damper" means a mechanical device designed to maintain a constant draft in a vented heater.

1.4 "Draft hood" means an external device which performs the same function as an integral draft diverter, as defined in section 1.17 of this appendix.

1.5 "Electro-mechanical stack damper" means a type of stack damper which is operated by electrical and/or mechanical means.

1.6 "Excess air" means air which passes through the combustion chamber and the vented heater flues in excess of that which is theoretically required for complete combustion.

1.7 "Flue" means a conduit between the flue outlet of a vented heater and the integral draft diverter, draft hood, barometric damper or vent terminal through which the flue gases pass prior to the point of draft relief.

1.8 "Flue damper" means a device installed between the furnace and the integral draft diverter, draft hood, barometric draft regulator, or vent terminal which is not equipped with a draft control device, designed to open the venting system when the appliance is in operation and to close the venting system when the appliance is in a standby condition.

1.9 "Flue gases" means reaction products resulting from the combustion of a fuel with the oxygen of the air, including the inerts and any excess air.

1.10 "Flue losses" means the sum of sensible and latent heat losses above room temperature of the flue gases leaving a vented heater.

1.11 "Flue outlet" means the opening provided in a vented heater for the exhaust of the flue gases from the combustion chamber.

1.12 "Heat input" (Q_{in}) means the rate of energy supplied in a fuel to a vented heater operating under steady-state conditions, expressed in Btu's per hour. It includes any input energy to the pilot light and is obtained by multiplying the measured rate of fuel consumption by the measured higher heating value of the fuel.

1.13 "Heating capacity" (Q_{out}) means rate of useful heat output from a heater, operating under steady-state tions, expressed in Btu's per hour. For and wall heaters, it is obtained by ing the "heat input" (Q_{in}) by the state efficiency (η_{ss}) divided by 100. For furnaces, it is obtained by multiplying the "heat input" (Q_{in}) by (B) the state efficiency divided by 100, minus quantity (2.8) (L_j) divided by 100, where the jacket loss as determined in section of this appendix.

1.14 "Higher heating value" means the heat produced per unit of when complete combustion takes constant pressure and the products of bustion are cooled to the initial tempe of the fuel and air and when the vapor formed during combustion is densed. The higher heating value is expressed in Btu's per pound, Btu's cubic foot for gaseous fuel, or Btu's gallon for liquid fuel.

1.15 "Induced draft" means a method drawing air into the combustion chamber mechanical means.

1.16 "Infiltration parameter" means portion of unconditioned outside air into the heated space as a consequence loss of conditioned air through the system of a vented heater.

1.17 "Integral draft diverter" means device which is an integral part of a heater, designed to: (1) Provide for the haust of the products of combustion in event of no draft, back draft, or beyond the draft diverter, (2) prevent back draft from entering the vented and (3) neutralize the stack action of chimney or gas vent upon the operation the vented heater.

1.18 "Manually controlled vented ers" means either gas or oil fueled heaters equipped without thermostats.

1.19 "Modulating control" means a step-modulating or two-stage control.

1.20 "Power burner" means a heater burner which supplies air for bustion at a pressure exceeding atmosp pressure, or a burner which depends on draft induced by a fan incorporated in furnace for proper operation.

1.21 "Reduced heat input rate" the factory adjusted lowest reduced input rate for vented home heating ment equipped with either two stage mostats or step-modulating thermostats.

1.22 "Single stage thermostat" thermostat that cycles a burner at the imum heat input rate and off.

1.23 "Stack" means the portion of exhaust system downstream of the draft diverter, draft hood or barom draft regulator.

1.24 "Stack damper" means a device in-
talled downstream of the integral draft di-
erter, draft hood, or barometric draft regu-
ator, designed to open the venting system
hen the appliance is in operation and to
lose off the venting system when the appli-
nce is in the standby condition.

1.25 "Stack gases" means the flue gases
mbined with dilution air that enters at
he integral draft diverter, draft hood or
arometric draft regulator.

1.26 "Steady-state conditions for vented
ome heating equipment" means equilibri-
m conditions as indicated by temperature
ariations of not more than 5° F (2.8C) in
he flue gas temperature for units equipped
ith draft hoods, barometric draft regula-
ors or direct vent systems, in three succes-
ive readings taken 15 minutes apart or not
ore than 3° F (1.7C) in the stack gas tem-
erature for units equipped with integral
raft diverters in three successive readings
aken 15 minutes apart.

1.27 "Step-modulating control" means a
ontrol that either cycles off and on at the
ow input if the heating load is light, or
radually, increases the heat input to meet
ny higher heating load that cannot be met
ith the low firing rate.

1.28 "Thermal stack damper" means a
ype of stack damper which is dependent for
peration exclusively upon the direct con-
ersion of thermal energy of the stack gases
nto movement of the damper plate.

1.29 "Two stage control" means a control
hat either cycles a burner at the reduced
eat input rate and off or cycles a burner at
he maximum heat input rate and off.

1.30 "Vaporizing-type oil burner" means
device with an oil vaporizing bowl or other
eceptacle designed to operate by vaporizing
iquid fuel oil by the heat of combustion
nd mixing the vaporized fuel with air.

1.31 "Vent/air intake terminal" means a
evice which is located on the outside of a
uilding and is connected to a vented heater
y a system of conduits. It is composed of
n air intake terminal through which the
ir for combustion is taken from the outside
tmosphere and a vent terminal from which
lue gases are discharged.

1.32 "Vent limiter" means a device which
imits the flow of air from the atmospheric
iaphragm chamber of a gas pressure regu-
ator to the atmosphere. A vent limiter may
e a limiting orifice or other limiting device.

1.33 "Vent pipe" means the passages and
onduits in a direct vent system through
hich gases pass from the combustion
hamber to the outdoor air.

2.0 *Testing conditions.*

2.1 *Installation of test unit.*

2.1.1 *Vented wall furnaces (including direct vent systems).* Install gas fueled vented wall furnaces for test as specified in
ections 2.1.3 and 2.1.4 of ANSI Z21.49-1975.
Install gas fueled wall furnaces with direct vent systems for test as described in sections 2.1.3 and 2.1.4 of ANSI Z21.44-1973. Install oil fueled vented wall furnaces as specified in UL-730-1974, section 33. Install oil fueled vented wall furnaces with direct vent systems as specified in UL-730-1974, section 34.

2.1.2 *Vented floor furnaces.* Install vented floor furnaces for test as specified in sections 35.1 through 35.5 of UL-729-1976.

2.1.3 *Vented room heaters.* Install in accordance with manufacturer's instructions.

2.2 *Flue and stack requirements.*

2.2.1 *Gas fueled vented home heating equipment employing integral draft diverters and draft hoods (excluding direct vent systems).* Attach to, and vertically above the outlet of gas fueled vented home heating equipment employing draft diverters or draft hoods with vertically discharging outlets, a five (5) foot long test stack having a cross sectional area the same size as the draft diverter outlet.

Attach to the outlet of vented heaters having a horizontally discharging draft diverter or draft hood outlet a 90 degree elbow, and a five (5) foot long vertical test stack. A horizontal section of pipe may be used on the floor furnace between the diverter and the elbow if necessary to clear any framing used in the installation. Use the minimum length of pipe possible for this section. Use stack, elbow, and horizontal section with same cross sectional area as the diverter outlet.

2.2.2 *Oil fueled vented home heating equipment (excluding direct vent systems).* Use flue connections for oil fueled vented floor furnaces as specified in section 35 of UL 729-1976, sections 34.10 through 34.18 of UL 730-1974 for oil fueled vented wall furnaces and sections 36.2 and 36.3 of UL 896-1973 for oil fueled vented room heaters.

2.2.3 *Direct vent systems.* Have the exhaust/air intake system supplied by the manufacturer in place during all tests. Test units intended for installation with a variety of vent pipe lengths with the minimum length recommended by the manufacturer. Do not connect a heater employing a direct vent system to a chimney or induced draft source. Vent the gas solely on the provision for venting incorporated in the heater and the vent/air intake system supplied with it.

2.3 *Fuel supply.*

2.3.1 *Natural gas.* For a vented heater utilizing natural gas, maintain the gas supply to the unit under test at a normal inlet test pressure immediately ahead of all controls at 7 to 10 inches water column. Maintain the regulator outlet pressure at normal test pressure approximately at that recommended by the manufacturer. Use natural gas having a specific gravity of approximately 0.65 and a higher heating value within ± 5 percent of 1,025 Btu's per standard cubic foot. Determine the actual higher heating value in Btu's per standard cubic foot for the natural gas to be used in the test with an error no greater than one percent.

2.3.2 *Propane gas.* For a vented heater utilizing propane gas, maintain the gas supply to the unit under test at a normal inlet pressure of 11 to 13 inches water column and a specific gravity of approximately 1.53. Maintain the regulator outlet pressure, on units so equipped, approximately at that recommended by the manufacturer. Use propane having a specific gravity of approximately 1.53 and a higher heating value within ± 5 percent of 2,500 Btu's per standard cubic foot. Determine the actual higher heating value in Btu's per standard cubic foot for the propane to be used in the test with an error no greater than one percent.

2.3.3 *Other test gas.* Use other test gases with characteristics as described in section 2.2, table VII, of ANSI Standard Z21.11.1-1974. Use gases with a measured higher heating value within ± 5 percent of the values specified in the above ANSI standard. Determine the actual higher heating value of the gas used in the test with an error no greater than one percent.

2.3.4 *Oil supply.* For a vented heater utilizing fuel oil, use No. 1, fuel oil (kerosene) for vaporizing-type burners and either No. 1 or No. 2 fuel oil, as specified by the manufacturer, for mechanical atomizing type burners. Use No. 1 fuel oil with a viscosity meeting the specifications as specified in UL-730-1974, section 36.9. Use test fuel conforming to the specifications given in tables 2 and 3 of ANSI Standard Z91.1-1972 for No. 1 and No. 2 fuel oil. Measure the higher heating value of the test fuel with an error no greater than one percent.

2.3.5 *Electrical supply.* For auxiliary electric components of a vented heater, maintain the electrical supply to the test unit within one percent of the nameplate voltage for the entire test cycle. If a voltage range is used for nameplate voltage, maintain the electrical supply within one percent of the mid-point of the nameplate voltage range.

2.4 *Burner adjustments.*

2.4.1 *Gas burner adjustments.* Adjust the burners of gas fueled vented heaters to their maximum Btu ratings at the test pressure specified in section 2.3 of this appendix. Correct the burner volumetric flow rate to 60° F (15.6C) and 30 inches of mercury barometric pressure, set the fuel flow rate to obtain a heat rate of within ±2 percent of the hourly Btu rating specified by the manufacturer as measured after 15 minutes of operation starting with all parts of the vented heater at room temperature. Set the primary air shutters in accordance with the manufacturer's recommendations to give a good flame at this adjustment. Do not allow
the deposit of carbon during any test
fied herein.

If a vent limiting means is provided
gas pressure regulator, have it in
during all tests.

For gas fueled heaters with modul
controls adjust the controls to operate
heater at the maximum fuel input rate
the thermostat control to the maximum
ting. Start the heater by turning the
control valve to the "on" position. In
to prevent modulation of the burner
maximum input, place the thermostat
ing element in a temperature control
which is held at a temperature below
maximum set point temperature of the
trol.

For gas fueled heaters with modul
controls adjust the controls to operate
heater at the reduced fuel input rate.
the thermostat control to the minimum
ting. Start the heater by turning the
control valve to the "on" position. If
ent test room temperature is above
lowest control set point temperature,
ate burner operation by placing the ther
stat sensing element in a temperature
trol bath that is held at a temper
below the minimum set point temper
of the control.

2.4.2 *Oil burner adjustments.* Adjust
burners of oil fueled vented heaters to
the CO_2 reading recommended by the
facturer and an hourly Btu input,
the steady-state performance test
below, which is within ±2 percent of
heater manufacturer's specified
hourly Btu input rating. On units
ing a power burner do not allow
the flue to exceed a No. 1 smoke during
steady-state performance test as
by the procedure in ANSI Stand
Z11.182-1965 (R1971) (ASTM D 21
(1970)). If, on units employing a
burner, the smoke in the flue exceeds a
1 smoke during the steady-state test,
just the burner to give a lower smoke
ing, and, if necessary a lower CO_2
and start all tests over. Maintain the
age draft over the fire and in the
during the steady-state performance test
that recommended by the manufactu
within ±0.005 inches of water gauge. Do
make additional adjustments to the bur
during the required series of perform
tests. The instruments and measuring
ratus for this test are described in
6.3 of ANSI standard Z91.1-1972.

2.5 *Circulating air adjustments.*

2.5.1 *Forced air vented wall furnaces*
cluding direct vent systems). During
maintain the air flow through the heater
specified by the manufacturer and oper
the vented heater with the outlet air
perature between 80° F and 130° F
room temperature. If adjustable air

charge registers are provided, adjust them so as to provide the maximum possible air restriction. Measure air discharge temperature as specified in section 2.14 of ANSI Z21.49-1975.

2.5.2 *Fan type vented room heaters and floor furnaces.* During tests on fan type furnaces and heaters, adjust the air flow through the heater as specified by the manufacturer. If adjustable air discharge registers are provided, adjust them to provide the maximum possible air restriction.

2.6 *Location of temperature measuring instrumentation.*

2.6.1 *Gas fueled vented home heating equipment (including direct vent systems).* For units employing an integral draft diverter, install nine thermocouples, wired in parallel, in a horizontal plane in the five foot test stack located one foot from the test stack inlet. Equalize the length of all thermocouple leads before paralleling. Locate one thermocouple in the center of the stack. Locate eight thermocouples along imaginary lines intersecting at right angles in this horizontal plane at points one third and two thirds of the distance between the center of the stack and the stack wall.

For units which employ a direct vent system, locate at least one thermocouple at the center of each flue way exiting the heat exchanger. Provide radiation shields if the thermocouples are exposed to burner radiation.

For units which employ a draft hood or units which employ a direct vent system which does not significantly preheat the incoming combustion air, install nine thermocouples, wired in parallel, in a horizontal plane located within 12 inches (304.8 mm) of the heater outlet and upstream of the draft hood on units so equipped. Locate one thermocouple in the center of the pipe and eight thermocouples along imaginary lines intersecting at right angles in this horizontal plane at points one third and two thirds of the distance between the center of the pipe and the pipe wall.

For units which employ direct vent systems that significantly preheat the incoming combustion air, install nine thermocouples, wired in parallel, in a plane parallel to and located within 6 inches (152.4 mm) of the vent/air intake terminal. Equalize the length of all thermocouple leads before paralleling. Locate one thermocouple in the center of the vent pipe and eight thermocouples along imaginary lines intersecting at right angles in this plane at points one third and two thirds of the distance between the center of the flue pipe and the pipe wall.

Use bead-type thermocouples having wire size not greater than No. 24 American Wire Gauge (AWG). If there is a possibility that the thermocouples could receive direct radiation from the fire, install radiation shields on the fire side of the thermocouples only and position the shields so that they do not touch the thermocouple junctions.

Install thermocouples for measuring conditioned warm air temperature as described in ANSI Z21.49-1975, section 2.14. Establish the temperature of the inlet air by means of single No. 24 AWG bead-type thermocouple, suitably shielded from direct radiation and located in the center of the plane of each inlet air opening.

2.6.2 *Oil fueled vented home heating equipment (including direct vent systems).* Install nine thermocouples, wired in parallel and having equal length leads, in a plane perpendicular to the axis of the flue pipe. Locate this plane at the position shown in Figure 34.4 of UL 730-1974, or Figures 35.1 and 35.2 of UL 729-1976 for a single thermocouple, except that on direct vent systems which significantly preheat the incoming combustion air, it shall be located within 6 inches (152.5 mm) of the outlet of the vent/air intake terminal. Locate one thermocouple in the center of the flue pipe and eight thermocouples along imaginary lines intersecting at right angles in this plane at points one third and two thirds of the distance between the center of the pipe and pipe wall.

Use bead-type thermocouples having a wire size not greater than No. 24 AWG. If there is a possibility that the thermocouples could receive direct radiation from the fire, install radiation shields on the fire side of the thermocouples only and position the shields so that they do not touch the thermocouple junctions.

Install thermocouples for measuring the conditioned warm air temperature as described in sections 35.12 through 35.17 of UL 730-1974. Establish the temperature of the inlet air by means of a single No. 24 AWG bead-type thermocouple, suitably shielded from direct radiation and located in the center of the plane of each inlet air opening.

2.7 *Combustion measurement instrumentation.* Analyze the samples of stack and flue gases for vented heaters to determine the concentration by volume of carbon dioxide present in the dry gas with instrumentation which will result in a reading having an accuracy of ±0.1 percentage points.

2.8 *Energy flow instrumentation.* Install one or more instruments, which measure the rate of gas flow or fuel oil supplied to the vented heater, and if appropriate, the electrical energy with an error no greater than one percent.

2.9 *Room ambient temperature.* During the time period required to perform all the testing and measurement procedures specified in section 3.0 of this appendix, maintain the room temperature within ±5° F (±2.8C) of the value T_{RA} measured during the steady-state performance test. At no time during these tests shall the room temperature exceed 100° F (37.8C) or fall below 65° F (18.3C).

Temperature (T_{RA}) shall be the arithmetic average temperature of the test area, determined by measurement with four No. 24 AWG bead-type thermocouples with junctions shielded against radiation, located approximately at 90-degree positions on a circle circumscribing the heater or heater enclosure under test, in a horizontal plane approximately at the vertical midpoint of the appliance or test enclosure, and with the junctions approximately 24 inches from sides of the heater or test enclosure and located so as not to be affected by other than room air. Locate a thermocouple at each elevation of draft relief inlet opening and combustion air inlet opening at a distance of approximately 24 inches from the inlet openings. The temperature of the air for combustion and the air for draft relief shall not differ more than ±5° F from room temperature as measured above.

2.10 *Equipment used to measure mass flow rate in flue and stack.* The tracer gas chosen for this task should have a density which is less than or approximately equal to the density of air. Use a gas unreactive with the environment to be encountered. Using instrumentation of either the batch or continuous type, measure the concentration of tracer gas with an error no greater than 2 percent of the value of the concentration measured.

3.0 *Testing and measurements.*

3.1 *Steady-state testing.*

3.1.1 *Gas fueled vented home heating equipment (including direct vent systems).* Set up the vented heater as specified in sections 2.1, 2.2, and 2.3 of this appendix. The draft diverter shall be in the normal open condition and the stack shall not be insulated. (Insulation of the stack is no longer required for the vented heater test.) Begin the steady-state performance test by operating the burner and the circulating air blower, on units so equipped, with the adjustments specified by sections 2.4.1 and 2.5 of this appendix, until steady-state conditions are attained as indicated by a temperature variation of not more than 3°F (1.7 C) in the stack gas temperature for vented heaters equipped with draft diverters or 5°F (2.8 C) in the flue gas temperature for vented heaters equipped with either draft hoods or direct vent systems; in three successive readings taken 15 minutes apart.

On units employing draft diverters, measure the room temperature (T_{RA}) as described in section 2.9 of this appendix and measure the steady-state stack gas temperature ($T_{S,SS}$) using the nine thermocouples located in the 5 foot test stack as specified in section 2.6.1 of this appendix. Secure a sample of the stack gases in the plane where $T_{S,SS}$ is measured or within 3.5 feet downstrea this plane. Determine the concentratio volume of carbon dioxide (X_{CO2S}) presen the dry stack gas. If the location of the sampling differs from the temperat measurement plane, there shall be no leaks through the stack between these locations.

On units employing draft hoods or di vent systems, measure the room tempe ture (T_{RA}) as described in section 2.9 of th appendix and measure the steady-state fl gas temperature ($T_{F,SS}$), using the nine ther mocouples located in the flue pipe as d scribed in section 2.6.1 of this appendi Secure a sample of the flue gas in the pla of temperature measurement and determ the concentration by volume of CO_2 (X_{CO2F} present in dry flue gas. In addition, for uni employing draft hoods, secure a sample the stack gas in a horizontal plane in th five foot test stack located one foot fr the test stack inlet; and determine the co centration by volume of CO_2 (X_{CO2S}) prese in dry stack gas.

Determine the steady-state heat in rate (Q_{in}) including pilot gas by multiply the measured higher heating value of th test gas by the steady-state gas input ra corrected to standard conditions of 60°F a 30 inches of mercury. Use measured val of gas temperature and pressure at th meter and the barometric pressure to co rect the metered gas flow rate to standa conditions.

After the above test measurements ha been completed on units employing draft d verters, secure a sample of the flue gases the exit of the heat exchanger(s) and dete mine the concentration of CO_2 (X_{CO2F} present. In obtaining this sample of fl gas, move the sampling probe around or u a sample probe with multiple sampli ports in order to assure that an avera value is obtained for the CO_2 concentratio For units with multiple heat exchanger ou lets, measure the CO_2 concentration in a sample from each outlet to obtain the ave age CO_2 concentration for the unit. A man fold (parallel connected sampling tube may be used to obtain this sample.

For heaters with single stage thermo control (wall mounted electric thermostat determine the steady state efficiency at th maximum fuel input rate as specified in se tion 2.4 of this appendix.

For gas fueled vented heaters equipp with either two stage thermostats or st modulating thermostats, determine t steady-state efficiency at the maximum fu input rate, as specified in section 2.4.1 o this appendix, and at the reduced fuel inp rate, as specified in section 2.4.1 of this a pendix.

For manually controlled gas fueled ven heaters, with various input rates determ the steady-state efficiency at a fuel input rate that is within ±5 percent of 50 percent of the maximum fuel input rate. If the heater is designed to use a control that precludes operation at other than maximum output (single firing rate) determine the steady state efficiency at the maximum input rate only.

3.1.2 *Oil fueled vented home heating equipment (including direct vent systems).* Set up and adjust the vented heater as specified in sections 2.1, 2.2, and 2.3.4 of this appendix. Begin the steady-state performance test by operating the burner and the circulating air blower, on units so equipped, with the adjustments specified by sections 2.4.2 and 2.5 of this appendix until steady-state conditions are attained as indicated by a temperature variation of not more than 5°F (2.8 C) in the flue gas temperature in three successive readings taken 15 minutes apart.

Do not allow smoke in the flue, for units equipped with power burners, to exceed a No. 1 smoke during the steady-state performance test as measured by the procedure described in ANSI standard Z11.182-1965 (R1971) (ASTM D 2156-65 (1970)). Maintain the average draft over the fire and in the breeching during the steady-state performance test at that recommended by the manufacturer ±0.005 inches of water gauge.

Measure the room temperature (T_{RA}) as described in section 2.9 of this appendix and measure the steady-state flue gas temperature ($T_{F,SS}$) using nine thermocouples located in the flue pipe as described in section 2.6.2 of this appendix. Secure a sample of the flue gas in the plane of temperature measurement and determine the concentration by volume of CO_2(X_{CO2F}) present in dry flue gas. Measure and record the steady-state heat input rate (Q_{in}).

For manually controlled oil fueled vented heaters, determine the steady-state efficiency at a fuel input rate that is within ±5 percent of 50 percent of the maximum fuel input rate.

3.1.3 *Auxiliary Electric Power Measurement.* Allow the auxiliary electrical system of a gas or oil vented heater to operate for at least five minutes before recording the maximum auxiliary electric power measurement from the wattmeter. Record the maximum electric power (P_E) expressed in kilowatts. For vented heaters with modulating controls, the recorded (P_E) shall be maximum measured electric power multiplied by the following factor (R). For two stage controls, R=1.3. For step modulating controls, R=1.4 when the ratio of minimum-to-maximum fuel input is greater than or equal to 0.7, R=1.7 when the ratio of minimum-to-maximum fuel input is less than 0.7 and greater than or equal to 0.5, and R=2.2 when the ratio of minimum-to-maximum fuel input is less than 0.5.

3.2 *Jacket loss measurement.* Conduct a jacket loss test for vented floor furnaces. Measure the jacket loss (L_J) in accordance with the ANSI standard Z21.48-1976 section 2.12.

3.3 *Measurement of the off-cycle losses for vented heaters equipped with thermal stack dampers.* Install the thermal stack damper according to the manufacturer's instructions. Unless specified otherwise, the thermal stack damper should be at the draft diverter exit collar. Attach a five foot length of bare stack to the outlet of the damper. Install thermocouples as specified in section 2.6.1 of this appendix.

For vented heaters equipped with single stage thermostats, measure the off-cycle losses at the maximum fuel input rate. For vented heaters equipped with two stage thermostats, measure the off-cycle losses at the maximum fuel input rate and at the reduced fuel input rate. For vented heaters equipped with step-modulating thermostats, measure the off-cycle losses at the reduced fuel input rate.

Let the vented heater heat up to a steady-state condition. Feed a tracer gas at a constant metered rate into the stack directly above and within one foot above the stack damper. Record tracer gas flow rate and temperature. Measure the tracer gas concentration in the stack at several locations in a horizontal plane through a cross section of the stack at a point sufficiently above the stack damper to ensure that the tracer gas is well mixed in the stack.

Continuously measure the tracer gas concentration and temperature during a 10 minute cool down period. Shut the burner off and immediately begin measuring tracer gas concentration in the stack, stack temperature, room temperature, and barometric pressure. Record these values as the midpoint of each one-minute interval between burner shut down and ten minutes after burner shut down. Meter response time and sampling delay time shall be considered in timing these measurements.

3.4 *Measurement of the effectiveness of electro-mechanical stack dampers.* For vented heaters equipped with electro-mechanical stack dampers, measure the cross sectional area of the stack (A_S), the net area of the damper plate (A_D), and the angle that the damper plate makes when closed with a plane perpendicular to the axis of the stack (Ω). The net area of the damper plate means the area of the damper plate minus the area of any holes through the damper plate.

3.5 *Pilot light measurement.* Measure the energy input rate to the pilot light (Q_P) with an error no greater than 3 percent for vented heaters so equipped.

3.6 *Optional procedure for determining* D_P, D_F and D_S *for systems for all types of vented heaters.* For all types of vented heaters, D_P, D_F and D_S can be measured by the following optional cool down test.

Conduct a cool down test by letting the unit heat up until steady-state conditions are reached, as indicated by temperature variation of not more than 5°F (2.8°C) in the flue gas temperature in three successive readings taken 15 minutes apart, and then shutting the unit off with the stack or flue damper controls by-passed or adjusted so that the stack or flue damper remains open during the resulting cool down period. If a draft was maintained on oil fueled units in the flue pipe during the steady-state performance test described in section 3.1 of this appendix, maintain the same draft (within a range of −.001 to +.005 inches of water gauge of the average steady-state draft) during this cool down period.

Measure the flue gas mass flow rate ($m_{F,OFF}$) during the cool down test described above at a specific off-period flue gas temperature and corrected to obtain its value at the steady-state flue gas temperature ($T_{F,SS}$), using the procedure described below.

Within one minute after the unit is shut off to start the cool down test for determining D_P, begin feeding a tracer gas into the combustion chamber at a constant flow rate of V_T, and at a point which will allow for the best possible mixing with the air flowing through the chamber. (On units equipped with an oil fired power burner, the best location for injecting this tracer gas appears to be through a hole drilled in the air tube.) Periodically measure the value of V_T with an instantaneously reading flow meter having an accuracy of ±3 percent of the quantity measured. Maintain V_T at less than 1 percent of the air flow rate through the furnace. If a combustible tracer gas is used, there should be a delay period between the time the burner gas is shut off and the time the tracer gas is first injected to prevent ignition of the tracer gas.

Between 5 and 6 minutes after the unit is shut off to start the cool down test, measure at the exit of the heat exchanger the average flue gas temperature, $T^*_{F,OFF}$. At the same instant the flue gas temperature is measured, also measure the percent volumetric concentration of tracer gas C_T in the flue gas in the same plane where $T^*_{F,OFF}$ is determined. Obtain the concentration of tracer gas using an instrument which will result in an accuracy of ±2 percent in the value of C_T measured. If use of a continuous reading type instrument results in a delay time between drawing of a sample and its analysis, this delay should be taken into account so that the temperature measurement and the measurement of tracer gas concentration coincide. In addition, determine the temperature of the tracer gas entering the flow meter (T_T) and the barometric pressure (P_B).

The rate of the flue gas mass f through the vented heater and the fac D_P, D_F, and D_S are calculated by the equations in sections 4.5.1 through 4.5.3 of th appendix.

4.0 *Calculations.*

4.1 *Annual fuel utilization efficiency f gas or oil fueled vented home heating equipment equipped without manual contr and without thermal stack dampers.* The following procedure determines the annual fuel utilization efficiency for gas or o fueled vented home heating equipment equipped without manual controls and without thermal stack dampers.

4.1.1 *System number.* Obtain the system number from Table 1 of this appendix.

4.1.2 *Off-cycle flue gas draft factor.* Based on the system number, determine the off-cycle flue gas draft factor (D_F) from Table 1 of this appendix.

4.1.3 *Off-cycle stack gas draft facto* Based on the system number, determine th off-cycle stack gas draft factor (D_S) fro Table 1 of this appendix.

4.1.4 *Pilot fraction.* Calculate the pilo fraction (P_F) expressed as a decimal and de fined as:

$P_F = Q_P / Q_{in}$

where:

Q_P = as defined in 3.5 of this appendix

Q_{in} = as defined in 3.1 of this appendix at th maximum fuel input rate

4.1.5 *Jacket loss for floor furnaces.* Dete mine the jacket loss (L_J) expressed as a pe cent and measured in accordance with se tion 3.2 of this appendix. For other vente heaters $L_J = 0.0$.

4.1.6 *Latent heat loss.* Based on the fue obtain the latent heat loss ($L_{L,A}$) from Tabl 2 of this appendix.

4.1.7 *Ratio of combustion air mass flo rate to stoichiometric air mass flow ra* Determine the ratio of combustion air ma flow rate to stoichiometric air mass flo rate ($R_{T,F}$), and defined as:

$R_{T,F} = A + B / X_{CO_2F}$

where:

A = as determined from Table 2 of this a pendix

B = as determined from Table 2 of this a pendix

X_{CO_2F} = as defined in 3.1 of this appendix

4.1.8 *Ratio of combustion and relief a mass flow rate to stoichiometric air ma flow rate.* For vented heaters equipped wit either an integral draft diverter or a draft ood, determine the ratio of combustion an relief air mass flow rate to stoichiometri air mass flow rate ($R_{T,S}$), and defined as:

$$R_{T,S} = A + [B / X_{CO_2S}]$$

where:

A=as determined from Table 2 of this appendix
B=as determined from Table 2 of this appendix
X_{CO_2}=as defined in 3.1 of this appendix

4.1.9 *Sensible heat loss at steady-state operation.* For vented heaters equipped with either an integral draft diverter or a draft hood, determine the sensible heat loss at steady-state operation ($L_{S,SS,A}$) expressed as a percent and defined as:

where:

$L_{S,SS,A}=C(R_{T,S}+D)(T_{S,SS}-T_{RA})$

C=as determined from Table 2 of this appendix
$R_{T,S}$=as defined in 4.1.8 of this appendix
D=as determined from Table 2 of this appendix
$T_{S,SS}$=as defined in 3.1 of this appendix
T_{RA}=as defined in 2.9 of this appendix

For vented heaters equipped without an integral draft diverter, determine ($L_{S,SS,A}$) expressed as a percent and defined as:

$L_{S,SS,A}=C(R_{T,F}+D)(T_{F,SS}-T_{RA})$

where:

C=as determined from Table 2 of this appendix
$R_{T,F}$=as defined in 4.1.7 of this appendix
D=as determined from Table 2 of this appendix
$T_{F,SS}$=as defined in 3.1 of this appendix
T_{RA}=as defined in 2.9 of this appendix

4.1.10 *Steady-state efficiency.* For vented heaters equipped with single stage thermostats, calculate the steady-state efficiency (excluding jacket loss, η_{SS}, expressed in percent and defined as:

$\eta_{SS}=100-L_{L,A}-L_{S,SS,A}$

where:

$L_{L,A}$=as defined in 4.1.6 of this appendix
$L_{S,SS,A}$=as defined in 4.1.9 of this appendix

For vented heaters equipped with either two stage thermostats or with step-modulating thermostats, calculate the steady-state efficiency at the reduced fuel input rate, η_{SS}.L, expressed in percent and defined as:

$\eta_{SS-L}=100-L_{L,A}-L_{S,SS,A}$

where:

$L_{L,A}$=as defined in 4.1.6 of this appendix
$L_{S,SS,A}$=as defined in 4.1.9 of this appendix in which $L_{S,SS,A}$ is determined at the reduced fuel input rate

For vented heaters equipped with two stage thermostats, calculate the steady-state efficiency at the maximum fuel input rate, η_{SS-H}, expressed in percent and defined as:

$\eta_{SS-H}=100-L_{L,A}-L_{S,SS,A}$

where:

$L_{L,A}$=as defined in 4.1.6 of this appendix
$L_{S,SS,A}$=as defined in 4.1.9 of this appendix in which $L_{S,SS,A}$ is measured at the maximum fuel input rate

For vented heaters equipped with step-modulating thermostats, calculate the weighted-average steady-state efficiency in the modulating mode, η_{SS-MOD}, expressed in percent and defined as:

$$\eta_{SS-MOD}=[\eta_{SS-H}-\eta_{SS-L}]\left[\frac{T_C-T_{OA^*}}{T_C-15}\right]+\eta_{SS-L}$$

where:

η_{SS-H}=as defined in 4.1.10 of this appendix
η_{SS-L}=as defined in 4.1.10 of this appendix
T_{OA^*}=average outdoor temperature for vented heaters with step-modulating thermostats operating in the modulating mode and is obtained from Table 3 or Figure 1 of this appendix
T_C=balance point temperature which represents a temperature used to apportion the annual heating load between the reduced input cycling mode and either the modulating mode or maximum input cycling mode and is obtained either from Table 3 of this appendix or calculated by the following equation:

$T_C=65-[(65-15)R]$

where:

65=average outdoor temperature at which a vented heater starts operating
15=national average outdoor design temperature for vented heaters
R=ratio of reduced to maximum heat output rates, as defined in 4.1.13 of this appendix

4.1.11 *Reduced heat output rate.* For vented heaters equipped with either two stage thermostats or step-modulating thermostats, calculate the reduced heat output rate
($Q_{red-out}$) defined as:

$Q_{red-out}=\eta_{SS-L}Q_{red-in}$

where:

η_{SS-L}=as defined in 4.1.10 of this appendix
Q_{red-in}=the reduced fuel input rate

4.1.12 *Maximum heat output rate.* For vented heaters equipped with either two stage thermostats or step-modulating thermostas, calculate the maximum heat output rate ($Q_{max-out}$) defined as:

$Q_{max.\ out}=\eta_{ss-H}\ Q_{max.\ in}$

where:

η_{ss-H}=as defined in 4.1.10 of this appendix

Q_{max-in}=the maximum fuel input rate

4.1.13 *Ratio of reduced to maximum heat output rates.* For vented heaters equipped with either two stage thermostats or step-modulating thermostats, calculate the ratio of reduced to maximum heat output rates (R) expressed as a decimal and defined as:

$R=Q_{red-out}/Q_{max-out}$

where:

$Q_{red-out}$=as defined in 4.1.11 of this appendix
$Q_{max-out}$=as defined in 4.1.12 of this appendix

4.1.14 *Fraction of heating load at reduced operating mode.* For vented heaters equipped with either two stage thermostats or step-modulating thermostats, determine the fraction of heating load at the reduced operating mode (X_1) expressed as a decimal and listed in Table 3 of this appendix or obtained from Figure 2 of this appendix.

4.1.15 *Fraction of heating load at maximum operating mode or noncycling mode.* For vented heaters equipped with either two stage thermostats or step-modulating therostats, determine the fraction of heating load at the maximum operating mode or noncycling mode (X_H) expressed as a decimal and listed in Table 3 of this appendix or obtained from Figure 2 of this appendix.

4.1.16 *Weighted-average steady-state efficiency.* For vented heaters equipped with single stage thermostats, the weighted-average steady-state efficiency (η_{ss-WT}) is equal to η_{ss}, as defined in section 4.1.10 of this appendix. For vented heaters equipped with two stage thermostats, η_{ss-WT} is defined as:

$\eta_{ss-WT}=X_1\eta_{ss-L}+X_H\eta_{ss-H}$

where:

X_1=as defined in 4.1.14 of this appendix
η_{ss-L}=as defined in 4.1.10 of this appendix
X_H=as defined in 4.1.15 of this appendix
η_{ss-H}=as defined in 4.1.10 of this appendix

For vented heaters equipped with step-modulating thermostats, η_{ss-WT} is defined as:

$\eta_{ss-WT}=X_1\eta_{ss-L}+X_H\eta_{ss-MOD}$

where:

X_1=as defined in 4.1.14 of this appendix
η_{ss-L}=as defined in 4.1.10 of this appendix
X_H=as defined in 4.1.15 of this appendix
η_{ss-MOD}=as defined in 4.1.10 of this appendix

4.1.17 *Annual fuel utilization efficiency.* Calculate the annual fuel utilization efficiency (AFUE) expressed as percent and defined as:

$AFUE=[0.968\eta_{ss-WT}]-1.78D_F-1.89D_S-129P_F-2.8\ L_J+1.81$

where:

η_{ss-WT}=as defined in 4.1.16 of this appendix
D_F=as defined in 4.1.2 of this appendix
D_S=as defined in 4.1.3 of this appendix
P_F=as defined in 4.1.4 of this appendix
L_J=as defined in 4.1.5 of this appendix

4.2 *Annual fuel utilization efficiency for gas or oil fueled vented home heating equipment equipped with manual controls.* The following procedure determines the annual fuel utilization efficiency for gas or oil fueled vented home heating equipment equipped with manual controls.

4.2.1 *Average ratio of stack gas mass flow rate to flue gas mass flow rate at steady-state operation.* For vented heaters equipped with either direct vents or direct exhaust or are outdoor units, the average ratio of stack gas mass flow rate to flue gas mass flow rate at steady-state operation (S/F) shall be equal to unity. (S/F=1.) For all other types of vented heaters, calculate (S/F) defined as:

$S/F=1.3R_{T,S}/R_{T,F}$

where:

$R_{T,S}$=as defined in 4.1.6 of this appendix with X_{CO_2S} measured at 50% fuel input rate
$R_{T,F}$=as defined in 4.1.7 of this appendix with X_{CO_2F} measured at 50% fuel input rate

4.2.2 *Multiplication factor for infiltration loss during burner on-cycle.* Calculate the multiplication factor for infiltration loss during burner on-cycle ($K_{I,ON}$) defined as:

$K_{I,ON}=100(0.24)\ (S/F)\ (0.7)\ [1+R_{T,F}(A/F)]/HHV_A$

where:

100=converts a decimal fraction into a percent
0.24=specific heat of air
A/F=stoichiometric air/fuel ratio, determined in accordance with Table 2 of this appendix
S/F=as defined in 4.2.1 of this appendix at 50 percent of rated maximum fuel input
0.7=infiltration parameter
$R_{T,F}$=as defined in 4.1.7 of this appendix
HHV_A=average higher heating value of the test fuel, determined in accordance with Table 2 of this appendix

4.2.3 *On-cycle infiltration heat loss.* Calculate the on-cycle infiltration heat loss ($L_{I,ON}$) expressed as a percent and defined as:

$L_{I,ON}=K_{I,ON}\ (70-45)$

where:

$K_{I,ON}$=as defined in 4.2.2 of this appendix
70=average indoor temperature
45=average outdoor temperature

4.2.4 *Weighted-Average Steady-State Efficiency.* For manually controlled heaters with various input rates the weighted average steady-state efficiency (η_{ss-WT}), is at 50 percent of the maximum fuel input rate as measured in either section 3.1.1 to this appendix for manually controlled gas vented heaters or section 3.1.2 to this appendix for manually controlled oil vented heaters. For manually controlled heater with one single firing rate the weighted average steady-state efficiency is the steady state efficiency measured at the single firing rate.

4.2.5 *Part-load fuel utilization efficiency.* Calculate the part-load fuel utilization efficiency (η_u) expressed as a percent and defined as:

$\eta_u = \eta_{SS\text{-}WT} - L_{I.ON}$

where:

$\eta_{SS\text{-}WT}$=as defined in 4.2.4 of this appendix
$L_{I.ON}$=as defined in 4.2.3 of this appendix

4.2.6 *Annual fuel utilization efficiency.* For manually controlled vented heaters. Calculate the annual fuel utilization efficiency (AFUE) expressed as a percent and defined as:

$$\mathrm{AFUE} = \frac{4400\eta_{SS}\eta_u Q_{in-max}}{4400\eta_{SS}Q_{in-max} + 2.5(4600)\eta_u Q_P}$$

where:

4400=average number of heating degree days
η_{SS}=as defined as $\eta_{SS\text{-}WT}$ in 4.2.4 of this appendix
η_u=as defined in 4.2.5 of this appendix
$Q_{in\text{-}max}$=as defined as Q_{in} at the maximum fuel input rate, as defined in 3.1 of this appendix
4600=average number of non-heating season hours per year
Q_P=as defined in 3.5 of this appendix

4.3 *Annual fuel utilization efficiency by the tracer gas method.* The annual fuel utilization efficiency shall be determined by the following tracer gas method for all vented heaters equipped with thermal stack dampers. All other types of vented heaters can elect to use the following tracer gas method, as an optional procedure.

4.3.1 *On-cycle sensible heat loss.* For vented heaters equipped with single stage thermostats, calculate the on-cycle sensible heat loss ($L_{S.ON}$) expressed as a percent and defined as:

$L_{S.ON} = L_{S.SS.A}$

where:

$L_{S.SS.A}$=as defined in 4.1.9 of this appendix

For vented heaters equipped with two stage thermostats, calculate $L_{S.ON}$ defined as:

$L_{S.ON} = X_1 L_{S.SS.A\text{-}red} + X_2 L_{S.SS.A\text{-}max}$

where:

X_1=as defined in 4.1.14 of this appendix
$L_{S.SS.A\text{-}red}$=as defined as $L_{S.SS.A}$ in 4.1.9 of this appendix at the reduced fuel input rate
X_2=as defined in 4.1.15 of this appendix
$L_{S.SS.A\text{-}max}$=as defined as $L_{S.SS.A}$ in 4.1.9 of this appendix at the maximum fuel input rate

For vented heaters with step-modulating thermostats, calculate $L_{S.ON}$ defined as:

$L_{S.ON} = X_1 L_{S.SS.A\text{-}red} + X_2 L_{S.SS.A\text{-}avg}$

where:

$X=_1$-as defined in 4.1.14 of this appendix
$L_{S.SS.A\text{-}red}$=as defined in 4.3.1 of this appendix
X_2=as defined in 4.1.15 of this appendix
$L_{S.SS.A\text{-}avg}$=average sensible heat loss for step-modulating vented heaters operating in the modulating mode

$$L_{S.SS.A-avg} = \left[[L_{S.SS.A-max} - L_{S.SS.A-red}] \left[\frac{T_C - T_{OA^*}}{TC - 15} \right] \right] + L_{S.SS.A-red}$$

where:

$L_{S.SS.A\text{-}avg}$=as defined in 4.3.1 of this appendix
T_C=as defined in 4.1.10 of this appendix
T_{OA^*}=as defined in 4.1.10 of this appendix
15=as defined in 4.1.10 of this appendix

4.3.2 *On-cycle infiltration heat loss.* For vented heaters equipped with single stage thermostats, calculate the on-cycle infiltration heat loss ($L_{I.ON}$) expressed as a percent and defined as:

$L_{I.ON} = K_{I.ON}(70-45)$

where:

$K_{I.ON}$=as defined in 4.2.2 of this appendix
70=as defined in 4.2.3 of this appendix
45=as defined in 4.2.3 of this appendix

For vented heaters equipped with two stage thermostats, calculate $L_{I.ON}$ defined as:

$L_{I.ON} = X_1 K_{I.ON\text{-}Max}(70-T_{OA^*}) + X_2 K_{I.ON.red}(70-T_{OA})$

where:

X_1=as defined in 4.1.14 of this appendix
$K_{I.ON\text{-}max}$=as defined as $K_{I.ON}$ in 4.2.2 of this appendix at the maximum heat input rate
70=as defined in 4.2.3 of this appendix
T_{OA^*}=as defined in 4.3.4 of this appendix
$K_{I.ON.red}$=as defined as $K_{I.ON}$ in 4.2.2 of this appendix at the minimum heat input rate
T_{OA}=as defined in 4.3.4 of this appendix
X_2=as defined in 4.1.15 of this appendix

For vented heaters equipped with step-modulating thermostats, calculate $L_{S.ON}$ defined as:

$L_{S.ON}=X_1K_{1.ON\text{-}avg}(70\text{-}T_{OA^*})+X_2K_{1.ON\text{-}red}(70\text{-}T_{OA})$

where:

X_1=as defined in 4.1.14 of this appendix

$$K_{1.on\text{-}avg}=\frac{[K_{1.on\text{-}max}+K_{1.ON.red}]}{2}$$

70=as defined in 4.2.3 of this appendix
T_{OA^*}=as defined in 4.3.4 of this appendix
X_2=as defined in 4.1.15 of this appendix
T_{OA}=as defined in 4.3.4 of this appendix

4.3.3 *Off-cycle sensible heat loss.* For vented heaters equipped with single stage thermostats, calculate the off-cycle sensible heat loss ($L_{S.OFF}$) at the maximum fuel input rate. For vented heaters equipped with step-modulating thermostats, calculate $L_{S.OFF}$ defined as:

$L_{S.OFF}=X_1L_{S.OFF.red}$

where:

X_1=as defined in 4.1.14 of this appendix
$L_{S.OFF.red}$=as defined as $L_{S.OFF}$ in 4.3.3 of this appendix at the reduced fuel input rate

For vented heaters equipped with two stage thermostats, calculate $L_{S.OFF}$ defined as:

$L_{S.OFF}=X_1L_{S.OFF.red}+X_2L_{S.OFF.Max}$

where:

X_1=as defined in 4.1.14 of this appendix
$L_{S.OFF.red}$=as defined as $L_{S.OFF}$ in 4.3.3 of this appendix at the reduced fuel input rate
X_2=as defined in 4.1.15 of this appendix
$L_{S.OFF.Max}$=as defined as $L_{S.OFF}$ in 4.3.3 of this appendix at the maximum fuel input rate

Calculate the off-cycle sensible heat loss ($L_{S.OFF}$) expressed as a percent and defined as:

$$L_{S.OFF}=\frac{100(0.24)}{Q_{in}t_{on}}\sum m_{S.OFF}(T_{S.OFF}-T_{RA})$$

where:

100=conversion factor for percent
0.24=specific heat of air in Btu per pound-°F
Q_{in}=fuel input rate, as defined in 3.1 of this appendix in Btu per minute (as appropriate for the firing rate)
t_{on}=average burner on-time per cycle and is 20 minutes
$\Sigma m_{S.OFF}(T_{S.OFF}-T_{RA})$=summation of the twenty values of the quantity, $m_{S.OFF}(T_{S.OFF}-T_{RA})$, measured in accordance with 3.3 of this appendix
$m_{S.OFF}$=stack gas mass flow rate pounds per minute

$$m_{S.OFF}=\frac{1.325\,P_BV_T(100-C_T)}{C_T(T_T+460)}$$

$T_{S.OFF}$=stack gas temperature measured in accordance with 3.3 of this appendix
T_{RA}=average room temperature measured in accordance with 3.3 of this appendix
P_B=barometric pressure in inches of mercury
V_T=flow rate of the tracer gas through the stack in cubic feet per minute
C_{T^*}=concentration by volume of the active tracer gas in the mixture in percent and is 100 when the tracer gas is a single component gas
C_T=concentration by volume of the active tracer gas in the diluted stack gas in percent
T_T=temperature of the tracer gas entering the flow meter in degrees Fahrenheit
(T_T+460)=absolute temperature of the tracer gas entering the flow meter in degrees Rankine

4.3.4 *Average outdoor temperature.* For vented heaters equipped with single stage thermostats, the average outdoor temperature (T_{OA}) is 45°F. For vented heaters equipped with either two stage thermostats or step-modulating thermostats, T_{OA} during the reduced operating mode is obtained from Table 3 or Figure 1 of this appendix. For vented heaters equipped with two stage thermostats, T_{OA^*} during the maximum operating mode is obtained from Table 3 or Figure 1 of this appendix.

4.3.5 *Off-cycle infiltration heat loss.* For vented heaters equipped with single stage thermostats, calculate the off-cycle infiltration heat loss ($L_{I.OFF}$) at the maximum fuel input rate. For vented heaters equipped with step-modulating thermostats, calculate $L_{I.OFF}$ defined as:

$L_{I.OFF}=X_1L_{I.OFF.red}$

where:

X_1=as defined in 4.1.14 of this appendix
$L_{I.OFF.red}$=as defined in $L_{I.OFF}$ in 4.3.3 of this appendix at the reduced fuel input rate

For vented heaters equipped with two stage thermostats, calculate $L_{I.OFF}$ defined as:

$L_{I.OFF}=X_1L_{I.OFF.red}+X_2L_{I.OFF.max}$

where:

X_1=as defined in 4.1.14 of this appendix

$L_{I,OFF,red}$=as defined as $L_{I,OFF}$ in 4.3.3 of this appendix at the reduced fuel input rate

X_2=as defined in 4.1.15 of this appendix

$L_{I,OFF,max}$=as defined as $L_{I,OFF}$ in 4.3.3 of this appendix at the maximum fuel input rate

Calculate the off-cycle infiltration heat loss ($L_{I,OFF}$) expressed as a percent and defined as:

$$L_{I,OFF}=\frac{100(0.24)(1.3)(0.7)(70-T_{OA})}{Q_{in}t_{on}}\sum m_{S,OFF}$$

where:

100=conversion factor for percent

0.24=specific heat of air in Btu per pound-°F

1.3=dimensionless factor for converting laboratory measured stack flow to typical field conditions

0.7=infiltration parameter

70=assumed average indoor air temperature, °F

T_{OA}=average outdoor temperature as defined in 4.3.4 of this appendix

Q_{in}=fuel input rate, as defined in 3.1 of this appendix in Btu per minute (as appropriate for the firing rate)

t_{on}=average burner on-time per cycle and is 20 minutes

$\Sigma m_{S,OFF}$=summation of the twenty values of the quantity, $m_{S,OFF}$, measured in accordance with 3.3 of this appendix

$m_{S,OFF}$=as defined in 4.3.3 of this appendix

4.3.6 *Part-load fuel utilization efficiency.* Calculate the part-load fuel utilization efficiency (η_u) expressed as a percent and defined as:

$$\eta_u=100-L_{L,A}-C_JL_J\left[\frac{t_{on}}{t_{on}+P_Ft_{OFF}}\right]+\quad[L_{S,ON}+L_{S,OFF}+L_{I,ON}+L_{I,OFF})$$

where:

C_J=2.8, adjustment factor

L_J=jacket loss as defined in 4.1.5

$L_{L,A}$=as defined in 4.1.6 of this appendix

t_{on}=as defined in 4.3.3 of this appendix

$L_{S,ON}$=as defined in 4.3.1 of this appendix

$L_{S,OFF}$=as defined in 4.3.3 of this appendix

$L_{I,ON}$=as defined in 4.3.2 of this appendix

$L_{I,OFF}$=as defined in 4.1.4 of this appendix

P_F=as defined in 4.1.4 of this appendix

t_{OFF}=average burner off-time per cycle and is 20 minutes

4.3.7 *Annual fuel utilization efficiency.* Calculate the annual fuel utilization efficiency (AFUE) expressed as a percent and defined as:

$$AFUE=\frac{4400\eta_{SS-WT}\eta_uQ_{in-max}}{4400\eta_{SS}Q_{in-max}+2.5(4600)\eta_uQ_P}$$

where:

4400=as defined in 4.2.6

η_{SS-WT}=as defined in 4.1.16 of this appendix

η_u=as defined in 4.3.6 of this appendix

Q_{in-max}=as defined in 4.2.6 of this appendix

4600=as defined in 4.2.6 of this appendix

Q_P=as defined in 3.5 of this appendix

4.4 *Stack damper effectiveness for vented heaters equipped with electro-mechanical stack dampers.* Determine the stack damper effectiveness for vented heaters equipped with electro-mechanical stack dampers (D_s), defined as:

$D_s=1.62\ [1-A_D\cos\Omega/A_s]$

where:

A_D=as defined in 3.4 of this appendix

Ω=as defined in 3.4 of this appendix

A_s=as defined in 3.4 of this appendix

4.5 *Addition requirements for vented home heating equipment using indoor air for combustion and draft control.* For vented home heating equipment using indoor air for combustion and draft control, D_F, as described in section 4.1.2 of this appendix, and D_S, as described in section 4.1.3 of this appendix, shall be determined from Table 1 of this appendix.

4.5.1 *Optional procedure for determining D_F for vented home heating equipment.* Calculate the ratio (D_F) of the rate of flue gas mass through the vented heater during the off-period, $M_{F,OFF}(T_{F,SS})$, to the rate of flue gas mass flow during the on-period, $M_{F,SS}(T_{F,SS})$, and defined as:

$D_F=M_{F,OFF}(T_{F,SS})/M_{F,SS}(T_{F,SS})$

For vented heaters in which no draft is maintained during the steady-state or cool down tests, $M_{F,OFF}(T_{F,SS})$ is defined as:

$$M_{F,OFF}(T_{F,SS})=M_{F,OFF}(T^{*}_{F,OFF})\left[\frac{T_{F,SS}-T_{RA}}{T^{*}_{F,OFF}-T_{RA}}\right]^{0.56}\left[\frac{T^{*}_{F,OFF}+460}{T_{F,SS}+460}\right]^{1.19}$$

For oil fueled vented heaters in which an imposed draft is maintained, as described in section 3.6 of this appendix, $M_{F,OFF}(T_{F,SS})$ is defined as:

$M_{F,OFF}(T_{F,SS})=M_{F,OFF}(T^{*}_{F,SS})$

where:

$T_{F,SS}$=as defined in 3.1.1 of this appendix
$T^{*}_{F,OFF}$=flue gas temperature during the off-period measured in accordance with 3.6 of this appendix in degrees Fahrenheit
T_{RA}=as defined in 2.9 of this appendix

$$M_{F,OFF}(T_{F,OFF})=\frac{1.325\ P_{B}V_{T}(100-C_{T})}{C_{T}(T_{T}+460)}$$

P_B=barometric pressure measured in accordance with 3.6 of this appendix in inches of mercury
V_T=flow rate of tracer gas through the vented heater measured in accordance with 3.6 of this appendix in cubic feet per minute
C_T=concentration by volume of tracer gas present in the flue gas sample measured in accordance with 3.6 of this appendix in percent
C_T^{*}=concentration by volume of the active tracer gas in the mixture in percent and is 100 when the tracer gas is a single component gas
T_T=the temperature of the tracer gas entering the flow meter measured in accordance with 3.6 of this appendix in degrees Fahrenheit
(T_T+460)=absolute temperature of the tracer gas entering the flow meter in degrees Rankine
$M_{F,SS}(T_{F,SS})=Q_{in}[R_{T,F}(A/F)+1]/[60HHV_A]$
Q_{in}=as defined in 3.1 of this appendix
$R_{T,F}$=as defined in 4.1.7 of this appendix
A/F=as defined in 4.2.2 of this appendix
HHV_A=as defined in 4.2.2 of this appendix

4.5.2 *Optional procedure for determining off-cycle draft factor for flue gas flow for vented heaters.* For systems numbered 1 thru 10, calculate the off-cycle draft factor for flue gas flow (D_F) defined as:

$D_F=D_P$

For systems numbered 11 or 12: $D_F=D_PD_0$

where:

D_P=as defined in 4.5.1. of this appendix
D_0=as defined in 4.4 of this appendix

4.5.3 *Optional procedure for determining off-cycle draft factor for stack gas flow for vented heaters.* Calculate the off-cycle draft factor for stack gas flow (D_S) defined as:

For systems numbered 1 or 2: $D_S=1.0$
For systems numbered 3 or $D_S=(D_P+0.79)/1.4$
For systems numbered 5 or 6: $D_S=D_0$
For systems numbered 7 or 8 and if $D_0(S/F)<1$: $D_S=D_0D_P$
For systems numbered 7 or 8 and if $D_0(S/F)>1$:

$D_S=D_0D_P+[0.85-D_0D_P]\quad[D_0(S/F)-1]/[S/F-1]$

where:

D_P=as defined in 4.5.1 of this appendix
D_0=as defined in 4.4 of this appendix

TABLE 1—OFF-CYCLE DRAFT FACTORS FOR FLUE GAS FLOW (D_P) AND FOR STACK GAS FLOW (D_S) FOR VENTED HOME HEATING EQUIPMENT EQUIPPED WITHOUT THERMAL STACK DAMPERS

System number	(D_P)	(D_S)	Burner type	Venting system type[1]
1	1.0	1.0	Atmospheric.	Draft hood or diverter
2	0.4	1.0	Power	Draft hood or diverter
3	1.0	1.0	Atmospheric.	Barometric draft regulator.
4	0.4	0.85	Power	Barometric draft regulator.
5	1.0	D_0	Atmospheric.	Draft hood or diverter with damper.
6	0.4	D_0	Power	Draft hood or diverter with damper.
7	1.0	D_0	Atmospheric.	Barometric draft regulator with damper.
8	0.4	D_0D_P	Power	Barometric draft regulator with damper.
9	1.0		Atmospheric.	Direct vent.
10	0.4		Power	Direct vent.
11	D_0		Atmospheric.	Direct vent with damper.
12	0.4 D_0		Power	Direct vent with damper.

[1] Venting systems listed with dampers means electro-mechanical dampers only.

TABLE 2—VALUES OF HIGHER HEATING VALUE (HHV($_A$), STOICHIOMETRIC AIR/FUEL (A/F), LATENT HEAT LOSS ($L_{L,A}$) AND FUEL-SPECIFIED PARAMETERS (A, B, C, AND D) FOR TYPICAL FUELS

Fuels	HHV_A (Btu/lb)	A/F	$L_{L,A}$	A	B	C	D
No. 1 oil	19,800	14.56	6.55	0.0679	14.22	0.0179	0.167
No. 2 oil	19,500	14.49	6.50	0.0667	14.34	0.0181	0.167
Natural gas	20,120	14.45	9.55	0.0919	10.96	0.0175	0.171
Manufactured gas	18,500	11.81	10.14	0.0965	10.10	0.0155	0.235
Propane	21,500	15.58	7.99	0.0841	12.60	0.0177	0.151
Butane	20,000	15.36	7.79	0.0808	12.93	0.0180	0.143

TABLE 3—FRACTION OF HEATING LOAD AT REDUCED OPERATING MODE (X1) AND AT MAXIMUM OPERATING MODE (X2), AVERAGE OUTDOOR TEMPERATURES (TOA AND TOA*), AND BALANCE POINT TEMPERATURE (TC) FOR VENTED HEATERS EQUIPPED WITH EITHER TWO-STAGE THERMOSTATS OR STEP-MODULATING THERMOSTATS

Heat output ratio *	X1	X2	TOA	TOA*	TC
0.20 to 0.24	.12	.88	57	40	53
0.25 to 0.29	.16	.84	56	39	51
0.30 to 0.34	.20	.80	54	38	49
0.35 to 0.39	.30	.70	53	36	46
0.40 to 0.44	.36	.64	52	35	44
0.45 to 0.49	.43	.57	51	34	42
0.50 to 0.54	.52	.48	50	32	39
0.55 to 0.59	.60	.40	49	30	37

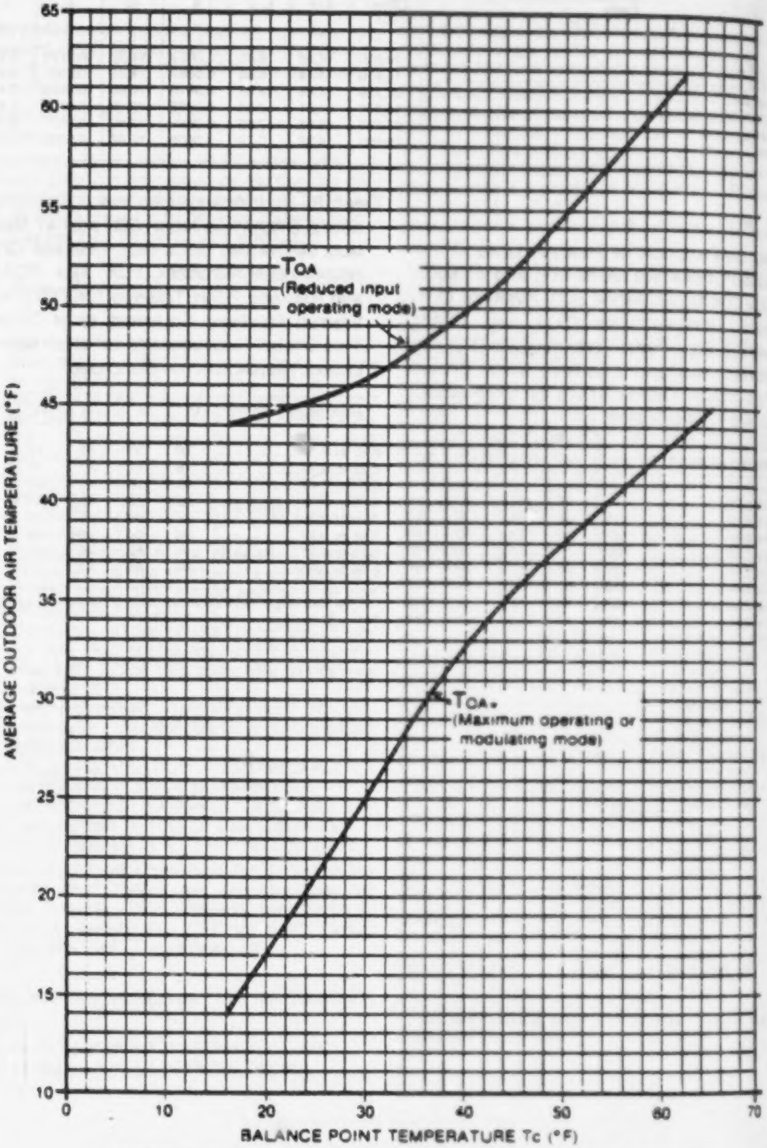
TABLE 3—FRACTION OF HEATING LOAD AT REDUCED OPERATING MODE (X1) AND AT MAXIMUM OPERATING MODE (X2), AVERAGE OUTDOOR TEMPERATURES (TOA AND TOA*), AND BALANCE POINT TEMPERATURE (TC) FOR VENTED HEATERS EQUIPPED WITH EITHER TWO-STAGE THERMOSTATS OR STEP-MODULATING THERMOSTATS—Continued

Heat output ratio *	X1	X2	TOA	TOA*	TC
0.60 to 0.64	.70	.30	48	29	34
0.65 to 0.69	.76	.24	47	27	32
0.70 to 0.74	.84	.16	46	25	29
0.75 to 0.79	.88	.12	46	22	27
0.80 to 0.84	.94	.06	45	20	23
0.85 to 0.89	.96	.04	45	18	21
0.90 to 0.94	.98	.02	44	16	19
0.95 to 0.99	.99	.01	44	13	17

* The heat output ratio means the ratio of minimum to maximum heat output rates as defined in 4.1.13.

FIGURE 1

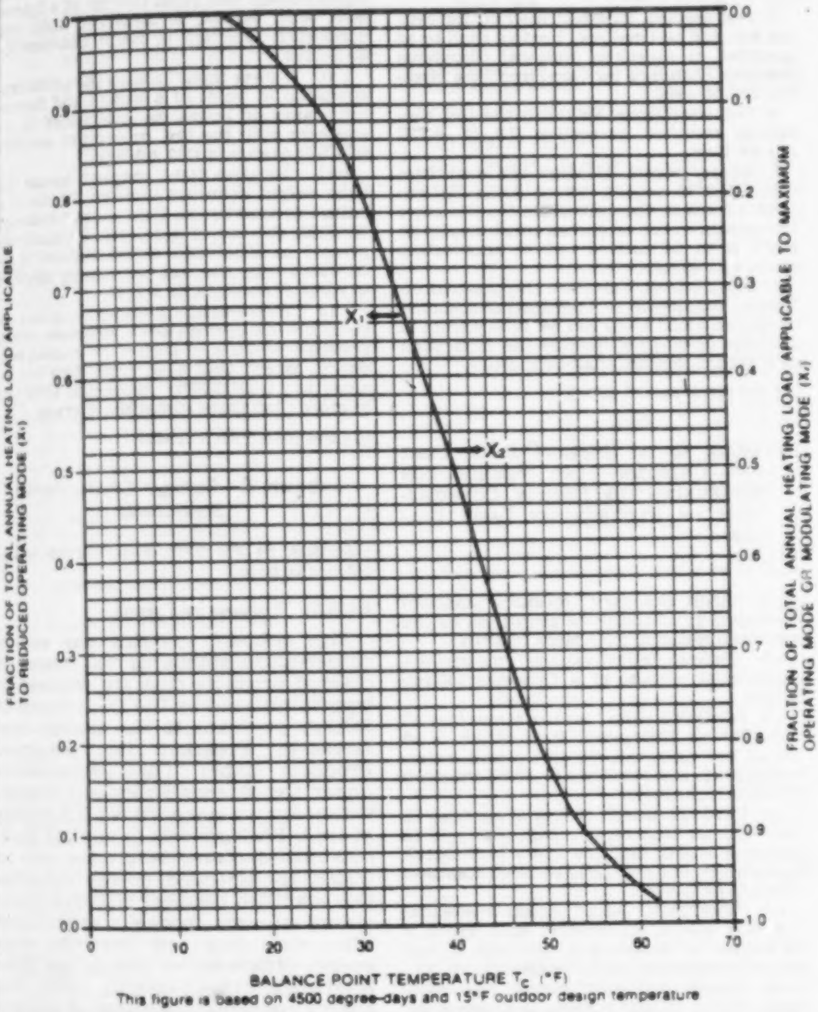
Average Outdoor Air Temperature vs. Balance Point Temperature for Modulating Vented Heaters



This figure is based on 4500 degree-days and 15°F outdoor design temperature

FIGURE 2

Fraction of Total Annual Heating Load Applicable to Reduced Operating Mode (X_1) and to Maximum Operating Mode or Modulating Mode (X_2) vs. Balance Point Temperature for Modulating Vented Heaters



This figure is based on 4500 degree-days and 15°F outdoor design temperature

[49 FR 12169, Mar. 28, 1984]

APPENDIX P TO SUBPART B OF PART 430—UNIFORM TEST METHOD FOR MEASURING THE ENERGY CONSUMPTION OF POOL HEATERS

1. *Test method.* The test method for testing gas- and oil-fired pool heaters shall be as specified in American National Standards Institute Standard for Gas-Fired Pool Heaters, Z21.56-1986.

2. *Test conditions.* Establish the test conditions specified in section 2.8 of ANSI Z21.56-1986.

3. *Measurements.* Measure the quantities delineated in section 2.8 of ANSI Z21.56-1986, except in the case of oil-fired heaters the measurement of energy consumption in Btu's is to be carried out in appropriate units, e.g., gallons.

4. *Calculations.* Calculate the thermal efficiency (expressed as a percent) as specified in section 2.8 of ANSI Z21.56-1986, except in the case of oil-fired heaters the expression of fuel consumption shall be in Btu's.

[54 FR 6076, Feb. 7, 1989]

APPENDIX Q TO SUBPART B OF PART 430—UNIFORM TEST METHOD FOR MEASURING THE ENERGY CONSUMPTION OF FLUORESCENT LAMP BALLASTS

1. Definitions

1.1 "ANSI Standard" means a standard developed by a committee accredited by the American National Standards Institute.

1.2 "Ballast input voltage" means the rated input voltage of a fluorescent lamp ballast.

1.3 "F40T12 lamp" means a nominal 40 watt tubular fluorescent lamp which is 48 inches in length and one and a half inches in diameter, and conforms to ANSI standard C78.1-1978(R1984).

1.4 "F96T12 lamp" means a nominal 75 watt tubular fluorescent lamp which is 48 inches in length and one and a half inches in diameter, and conforms to ANSI standard C78.1-1978(R1984).

1.5 "F96T12HO lamp" means a nominal 110 watt tubular fluorescent lamp which is 96 inches in length and one and a half inches in diameter, andto operate.

1.6 "Input current" means the root-mean-square (RMS) current in amperes delivered to a fluorescent lamp ballast.

1.7 "Luminaire" means a complete lighting unit consisting of a fluorescent lamp or lamps, together with parts designed to distribute the light, to position and protect such lamps, and to correct such lamps to the power supply through the ballast.

1.8 "Nominal lamp watts means the wa age at which a fluorescent lamp is desig to operate.

1.9 "Power factor" means the pow input divided by the product of balla input voltage and input current of a fluore cent lamp ballast, as measured under te conditions specified in ANSI Standard C 82.2-1984.

1.10 "Power input" means the power co sumption in watts of a ballast and fluore cent lamp or lamps, as determined in ac cordance with the test procedures specifie in ANSI Standard C82.2-1984.

1.11 "Relative light output" means th light output delivered through the use of a ballast divided by the light output delivere through the use of a reference ballast, ex pressed as a percent, as determined in ac cordance with the test procedures specifie in ANSI Standard C82.2-1984.

1.12 "Residential building" means a structure or portion of a structure which provides facilities or shelter for human resi dency, except that such term does not in clude any multifamily residential structur of more than three stores above grade.

[54 FR 6076, Feb. 7, 1989]

Subpart C—Energy Conservation Standards

SOURCE: 54 FR 6077, Feb. 7, 1989, unle otherwise noted.

§ 430.31 Purpose and scope.

This subpart contains any energ conservation standards for classes o covered products that are required t be administered by the Department o Energy pursuant to the Energy Con servation Program for Consume Products Other Than Automobile under the Energy Policy and Conse vation Act, as amended (42 U.S.C. 62 *et seq.*). Basic models of covered prod ucts manufactured before the date o which an amended energy conserv tion standard becomes effective (or re visions of such models manufacture after such date and have the sam energy efficiency or energy use char acteristics) that comply with th energy conservation standard applica ble to such covered products on th day before such date shall be deeme to comply with the amended energ conservation standard.

EFFECTIVE DATE NOTE: At 55 FR 4217 Oct. 17, 1990, § 430.31 was amended b adding a new sentence at the end of the section, effective April 15, 1991.

§ 430.32 Energy conservation standards and effective dates.

The energy conservation standards for the covered product classes are:

(a) *Refrigerators/refrigerator-freezers/freezers.*

Product class	Energy standards equations, Jan. 1, 1990
1. Refrigerators and refrigerator-freezers with manual defrost	16.3 AV+316
2. Refrigerator-freezers—partial automatic defrost	21.8 AV+429
3. Refrigerator-freezers-automatic defrost with top-mounted freezer without ice	23.5 AV+471
4. Refrigerator-freezers—automatic defrost with side-mounted freezer without ice	27.7 AV+488
5. Refrigerator-freezers—automatic defrost with bottom-mounted freezer without ice	27.7 AV+488
6. Refrigerator-freezers-automatic defrost with top-mounted freezer with through the door ice service	26.4 AV+535
7. Refrigerator-freezers—automatic defrost with side-mounted freezer with through the door ice	30.9 AV+547
8. Upright freezers with manual defrost	10.9 AV+422
9. Upright freezers with automatic defrost	16.0 AV+623
10. Chest freezers and all other freezers	14.8 AV+223

AV=Total adjusted volume, expressed in $ft.^3$

(b) *Room air conditioners.*

Product class	Energy efficiency ratio Jan. 1, 1990
1. Without reverse cycle and with louvered sides less than 6,000 Btu	8.0
2. Without reverse cycle and with louvered sides 6,000 to 7,999 Btu	8.5.
3. Without reverse cycle and with louvered sides 8,000 to 13,999 Btu	9.0
4. Without reverse cycle and with louvered sides 14,000 to 19,999 Btu	8.8
5. Without reverse cycle and with louvered sides 20,000 and more Btu	8.2
6. Without reverse cycle and without louvered sides Less than 6,000 Btu	8.0
7. Without reverse cycle and without louvered sides 6,000 to 7,999 Btu	8.5
8. Without reverse cycle and without louvered sides 8,000 to 13,999 Btu	8.5
9. Without reverse cycle and without louvered sides 14,000 to 19,999 Btu	8.5
10. Without reverse cycle and without louvered sides 20,000 and more Btu	8.2
11. With reverse cycle, and with louvered sides	8.5
12. With reverse cycle, without louvered sides	8.0

(c) *Central air conditioners and central air conditioning heat pumps.*

Product class	Seasonal energy efficiency ratio	Heating seasonal performance factor	Effective date
1. Split systems	10.0	6.8	01/01/92
2. Single package systems	9.7	6.6	01/01/93

(d) *Water heaters.*

The energy factor of water heaters shall not be less than the following products manufactured on or after the indicated dates:

Product class	Energy factor, as of Jan. 1, 1990	Energy factor, as of April 15, 1991
1. Gas Water Heater.	0.62−(.0019 × Rated Storage Volume in gallons).	0.62−(.0019 × Rated Storage Volume in gallons).
2. Oil Water Heater.	0.59−(.0019 × Rated Storage Volume in gallons).	0.59−(.0019 × Rated Storage Volume in gallons).
3. Electric Water Heater.	0.95−(.00132 × Rated Storage Volume in gallons).	0.93−(.00132 × Rated Volume Storage in gallons).

Note: Rated Storage Volume=the water storage capacity of a water heater, in gallons, as specified by the manufacturer.

(e) *Furnaces*

Product class	Annual fuel utilization efficiency	Effective date
1. Furnaces (excluding classes noted below) (percent)	78	01/01/92
2. Mobile Home Furnaces (percent)	75	09/01/90
3. "Small" furnaces (input rate less than 45,000 Btu/hour	(1)	01/01/92
4. Boilers (excluding gas steam) (percent)	80	01/01/92
5. Gas steam boilers (percent)	75	01/01/92

[1] Reserved.

(f) *Dishwashers.* Dishwashers must be equipped with an option to dry without heat. The standard was effective on January 1, 1988.

(g) *Clothes washers.* Clothes washers must have an unheated water rinse option. The standard was effective on January 1, 1988.

(h) *Clothes dryers.* Constant burning pilot lights in gas clothes dryers are prohibited. The standard was effective on January 1, 1988.

(i) *Direct heating equipment.*

Product class	Annual fuel utilization efficiency, Jan. 1, 1990 (percent)
1. Gas wall fan type up to 42,000 Btu/hour	73
2. Gas wall fan type over 42,000 Btu/hour	74
3. Gas wall gravity type up to 10,000 Btu/hour	59
4. Gas wall gravity type over 10,000 Btu/hour up to 12,000 Btu/hour	60
5. Gas wall gravity type over 12,000 Btu/hour up to 15,000 Btu/hour	61
6. Gas wall gravity type over 15,000 Btu/hour up to 19,000 Btu/hour	62
7. Gas wall gravity type over 19,000 Btu/hour up to 27,000 Btu/hour	63
8. Gas wall gravity type over 27,000 Btu/hour up to 46,000 Btu/hour	64
9. Gas wall gravity type over 46,000 Btu/hour	65
10. Gas floor up to 37,000 Btu/hour	56
11. Gas floor over 37,000 Btu/hour	57
12. Gas room up to 18,000 Btu/hour	57
13. Gas room over 18,000 Btu/hour up to 20,000 Btu/hour	58
14. Gas room over 20,000 Btu/hour up to 27,000 Btu/hour	60
15. Gas room over 27,000 Btu/hour up to 46,000 Btu/hour	64
16. Gas room over 46,000 Btu/hour	65

(j) *Kitchen ranges and ovens.* Gas kitchen ranges and ovens with an electrical supply cord shall not be equipped with a constant burning pilot. The standard is effective on January 1, 1990.

(k) *Pool heaters.* The thermal efficiency of pool heaters must be no less than 78%. The standard is effective on January 1, 1990.

(l) *Television sets.* [Reserved]

(m) *Fluorescent lamp ballasts.* (1) Except as provided in paragraph (m)(2) of this section, each fluorescent lamp ballast—

(i)(A) Manufactured on or after January 1, 1990;

(B) Sold by the manufacturer on or after April 1, 1990; or

(C) Incorporated into a luminarie by a luminarie manufacturer on or after April 1, 1991; and

(ii) Designed—

(A) To operate at nominal input vo tages of 120 or 277 volts;

(B) To operate with an input curre frequency of 60 Hertz; and

(C) For use in connection wi F40T12, F96T12, or F96T12HO lamp shall have a power factor of 0.90 o greater and shall have a ballast effic cy factor not less than the following

Application for operation of	Ballast input voltage	Total nominal lamp watts	[illegible]
One F40T12 lamp	120	40	[illegible]
	277	40	[illegible]
Two F40T12 lamps	120	80	[illegible]
	277	80	[illegible]
Two F96T12 lamps	120	150	[illegible]
	277	150	[illegible]
Two F96T12HO lamps	120	220	[illegible]
	277	220	[illegible]

(2) The standards described in para graph (m)(1) of this section do no apply to (i) a ballast which is designe for dimming or for use in ambien temperatures of 0°F or less, or (ii) a ballast which has a power factor of less than 0.90 and is designed for us only in residential building applic tions.

[54 FR 6077, Feb. 7, 1989, as amended at 5 FR 42177, Oct. 17, 1990]

EFFECTIVE DATE NOTE 1: At 54 FR 4794 Nov. 17, 1989, §430.32 was amended by revi ing paragraph (a), effective January 1, 199 and amending the Table headings and Ite 3 in paragraph (e), effective January 1 1992. At 55 FR 42847, Oct. 24, 1990, § 430.3 paragraph (e) was corrected. The text whic will become effective January 1, 1993, an January 1, 1992, follows below:

§ 430.32 Energy conservation standards and e fective dates.

* * * * *

(a) *Refrigerators/refrigerator-freezer freezers.* These standards do not apply to re frigerator and refrigerator-freezers wit total refrigerated volume exceeding 39 cubi feet or freezers with total refrigerate volume exceeding 30 cubic feet.

Product class	Energy standards equations (Kwh/yr) Effective dates	
	January 1, 1990	January 1, 1993
1. Refrigerators and Refrigerator-Freezers with manual defrost	(16.3AV+316)	(13.5AV+299)
2. Refrigerator-Freezer—partial automatic defrost	(21.8AV+429)	(10.4AV+398)
3. Refrigerator-Freezers—automatic defrost with: Top-mounted freezer without through-the-door ice service [1]	(23.5AV+471)	(16.0AV+355)
4. Refrigerator-Freezers—automatic defrost with: Side-mounted freezer without through-the-door ice service	(27.7AV+488)	(11.8AV+501)
5. Refrigerator-Freezers—automatic defrost with: Bottom-mounted freezer without through-the-door ice service	(27.7AV+488)	(16.5AV+367)
6. Refrigerator-Freezers—automatic defrost with: Top-mounted freezer with through-the-door ice service	(26.4AV+535)	(17.6AV+391)
7. Refrigerator-Freezers—automatic defrost with: Side-mounted freezer with through-the-door ice service	(30.9AV+547)	(16.3AV+527)
8. Upright Freezers with: Manual defrost	(10.9AV+422)	(10.3AV+264)
9. Upright Freezers with: Automatic defrost	(16.0AV+623)	(14.9AV+391)
10. Chest Freezers and all other Freezers	(14.8AV+223)	(11.0AV+160)

[1] Including all refrigerators with automatic defrost

AV=Total adjusted volume, expressed in $Ft.^3$, as determined in Appendices A1 and B1 of Subpart B of this Part.

* * * * *

(e) *Furnaces.*

Product class	AFUE [1] (percent)	Effective date
*	*	*
3. Small furnaces (other than furnaces designed solely for installation in mobile homes) having an input rate of less than 45,000 Btu/hr		
(A) Weatherized (outdoor).	78	January 1, 1992.
(B) Non-weatherized (indoor).	78	January 1, 1992.

[1] Annual Fuel Utilization Efficiency, as determined in §430.22(n)(2) of this part.

EFFECTIVE DATE NOTE 2: At 55 FR 42177, Oct. 17, 1990, § 430.32 was amended by revising paragraph (d), effective April 15, 1991. For the convenience of the user, the superseded text follows.

§ 430.32 Energy conservation standards and effective dates.

* * * * *

(d) *Water heaters*

Product class	Energy factor, Jan. 1, 1990
1. Gas Water Heater	0.62—(.0019 x Rated Storage Volume in gallons).
2. Oil Water Heater	0.59—(.0019 x Rated Storage Volume in gallons).
3. Electric Water Heater	0.95—(.00132 x Rated Storage Volume in gallons).

§ 430.33 Preemption of state regulations.

Any state regulation providing for any energy conservation standard, or other requirement with respect to the energy efficiency or energy use, of a covered product that is not identical to a Federal standard in effect under this subpart is preempted by that standard, except as provided for in section 327 (b) and (c) of the Act.

Subpart D—Petitions To Exempt State Regulation From Preemption; Petitions to Withdraw Exemption of State Regulation

SOURCE: 54 FR 6078, Feb. 7, 1989, unless otherwise noted.

§ 430.40 Purpose and scope.

(a) The regulations in this subpart prescribe the procedures to be followed in connection with petitions requesting a rule that a State regulation prescribing an energy conservation standard or other requirement respecting energy use or energy efficiency of a type (or class) of covered product not be preempted.

(b) The regulations in this subpart also prescribe the procedures to be followed in connection with petitions to withdraw a rule exempting a State regulation prescribing an energy conservation standard or other requirement respecting energy use or energy efficiency of a type (or class) of covered product.

§ 430.41 Prescriptions of a rule.

(a) *Criteria for exemption from preemption.* Upon petition by a State which has prescribed an energy conservation standard or other requirement for a type or class of a covered product for which a Federal energy conservation standard is applicable, the Secretary shall prescribe a rule that such standard not be preempted if he determines that the State has established by a preponderance of the evidence that such requirement is needed to meet unusual and compelling State or local energy interests. For the purposes of this regulation, the term "unusual and compelling State or local energy interests" means interests which are substantially different in nature or magnitude than those prevailing in the U.S. generally; and are such that when evaluated within the context of the State's energy plan and forecast, the costs, benefits, burdens, and reliability of energy savings resulting from the State regulation make such regulation preferable or necessary when measured against the costs, benefits, burdens, and reliability of alternative approaches to energy savings or production, including reliance on reasonably predictable market-induced improvements in efficiency of all products subject to the State regulation. The Secretary may not prescribe such a rule if he finds that interested persons have established, by a preponderance of the evidence, that the State's regulation will significantly burden manufacturing, marketing, distribution, sale or servicing of the covered product on a national basis. In determining whether to make such a finding, the Secretary shall evaluate all relevant factors including: The extent to which the State regulation will increase manufacturing or distribution costs of manufacturers, distributors, and others; the extent to which the State regulation will disadvantage smaller manufacturers, distributors, or dealers or lessen competition in the sale of the covered product in the State; the extent to which the State regulation would cause a burden to manufacturers to redesign and produce the covered product type (or class), taking into consideration the extent to which the regulation would result in a reduction in the current models, or in the projected availability of models, that could be shipped on the effective date of the regulation to the State and within the U.S., or in the current or projected sales volume of the covered product type (or class) in the State and the U.S.; and the extent to which the State regulation is likely to contribute significantly to a proliferation of State appliance efficiency requirements and the cumulative impact such requirements would have. The Secretary may not prescribe such a rule if he finds that such a rule will result in the unavailability in the State of any covered product (or class) of performance characteristics (including reliability), features, sizes, capacities, and volumes that are substantially the same as those generally available in the State at the time of the Secretary's finding. The failure of some classes (or types) to meet this criterion shall not affect the Secretary's determination of whether to prescribe a rule for other classes (or types).

(1) Requirements of petition for exemption from preemption. A petition from a State for a rule for exemption from preemption shall include the information listed in paragraphs (a)(1)(i) through (a)(1)(viii) of this section. A petition for a rule and correspondence relating to such petition shall be available for public review except for confidential or proprietary information submitted in accordance with the Department of Energy's Freedom of Information Regulations set forth in 10 CFR Part 1004:

(i) The name, address and telephone number of the petitioner;

(ii) A copy of the State standard for which a rule exempting such standard is sought;

(iii) A copy of the State's energy plan and forecast;

(iv) Specification of each type or class of covered product for which a rule exempting a standard is sought;

(v) Other information, if any, believed to be pertinent by the petitioner; and

(vi) Such other information as the Secretary may require.

(b) *Criteria for exemption from preemption when energy emergency con-*

ditions exist within State. Upon petition by a State which has prescribed an energy conservation standard or other requirement for a type or class of a covered product for which a Federal energy conservation standard is applicable, the Secretary may prescribe a rule, effective upon publication in the FEDERAL REGISTER, that such regulation not be preempted if he determines that in addition to meeting the requirements of paragraph (a) of this section the State has established that: an energy emergency condition exists within the State that imperils the health, safety and welfare of its residents because of the inability of the State or utilities within the State to provide adequate quantities of gas or electric energy to its residents at less than prohibitive costs; and cannot be substantially alleviated by the importation of energy or the use of interconnection agreements; and the State regulation is necessary to alleviate substantially such condition.

(1) Requirements of petition for exemption from preemption when energy emergency conditions exist within a State. A petition from a State for a rule for exemption from preemption when energy emergency conditions exist within a State shall include the information listed in paragraphs (a)(1)(i) through (a)(1)(vi) of this section. A petition shall also include the information prescribed in paragraphs (b)(1)(i) through (b)(1)(iv) of this section, and shall be available for public review except for confidential or proprietary information submitted in accordance with the Department of Energy's Freedom of Information Regulations set forth in 10 CFR Part 1004:

(i) A description of the energy emergency condition which exists within the State, including causes and impacts.

(ii) A description of emergency response actions taken by the State and utilities within the State to alleviate the emergency condition;

(iii) An analysis of why the emergency condition cannot be alleviated substantially by importation of energy or the use of interconnection agreements;

(iv) An analysis of how the State standard can alleviate substantially such emergency condition.

(c) *Criteria for withdrawal of a rule exempting a State standard.* Any person subject to a State standard which, by rule, has been exempted from Federal preemption and which prescribes an energy conservation standard or other requirement for a type or class of a covered product, when the Federal energy conservation standard for such product subsequently is amended, may petition the Secretary requesting that the exemption rule be withdrawn. The Secretary shall consider such petition in accordance with the requirements of paragraph (a) of this section, except that the burden shall be on the petitioner to demonstrate that the exemption rule received by the State should be withdrawn as a result of the amendment to the Federal standard. The Secretary shall withdraw such rule if he determines that the petitioner has shown the rule should be withdrawn.

(1) Requirements of petition to withdraw a rule exempting a State standard. A petition for a rule to withdraw a rule exempting a State standard shall include the information prescribed in paragraphs (c)(1)(i) through (c)(1)(vii) of this section, and shall be available for public review, except for confidential or proprietary information submitted in accordance with the Department of Energy's Freedom of Information Regulations set forth in 10 CFR Part 1004:

(i) The name, address and telephone number of the petitioner;

(ii) A statement of the interest of the petitioner for which a rule withdrawing an exemption is sought;

(iii) A copy of the State standard for which a rule withdrawing an exemption is sought;

(iv) Specification of each type or class of covered product for which a rule withdrawing an exemption is sought;

(v) A discussion of the factors contained in paragraph (a) of this section;

(vi) Such other information, if any, believed to be pertinent by the petitioner; and

(vii) Such other information as the Secretary may require.

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§ 430.42 Filing requirements.

(a) *Service.* All documents required to be served under this subpart shall, if mailed, be served by first class mail. Service upon a person's duly authorized representative shall constitute service upon that person.

(b) *Obligation to supply information.* A person or State submitting a petition is under a continuing obligation to provide any new or newly discovered information relevant to that petition. Such information includes, but is not limited to, information regarding any other petition or request for action subsequently submitted by that person or State.

(c) *The same or related matters.* A person or State submitting a petition or other request for action shall state whether to the best knowledge of that petitioner the same or related issue, act, or transaction has been or presently is being considered or investigated by any State agency, department, or instrumentality.

(d) *Computation of time.* (1) Computing any period of time prescribed by or allowed under this subpart, the day of the action from which the designated period of time begins to run is not to be included. If the last day of the period is Saturday, or Sunday, or Federal legal holiday, the period runs until the end of the next day that is neither a Saturday, or Sunday or Federal legal holiday.

(2) Saturdays, Sundays, and intervening Federal legal holidays shall be excluded from the computation of time when the period of time allowed or prescribed is 7 days or less.

(3) When a submission is required to be made within a prescribed time, DOE may grant an extension of time upon good cause shown.

(4) Documents received after regular business hours are deemed to have been submitted on the next regular business day. Regular business hours for the DOE's National Office, Washington, DC, are 8:30 a.m. to 4:30 p.m.

(5) DOE reserves the right to refuse to accept, and not to consider, untimely submissions.

(e) *Filing of petitions.* (1) A petition for a rule shall be submitted in triplicate to: The Assistant Secretary for Conservation and Renewable Energy, U.S. Department of Energy, Section 327 Petitions, Appliance Efficiency Standards, Forrestal Building, 1000 Independence Avenue, SW., Washington, DC 20585.

(2) A petition may be submitted on behalf of more than one person. A joint petition shall indicate each person participating in the submission. A joint petition shall provide the information required by § 430.41 for each person on whose behalf the petition is submitted.

(3) All petitions shall be signed by the person(s) submitting the petition or by a duly authorized representative. If submitted by a duly authorized representative, the petition shall certify this authorization.

(4) A petition for a rule to withdraw a rule exempting a State regulation, all supporting documents, and all future submissions shall be served on each State agency, department, or instrumentality whose regulation the petitioner seeks to supersede. The petition shall contain a certification of this service which states the name and mailing address of the served parties and the date of service.

(f) *Acceptance for filing.* (1) Within fifteen (15) days of the receipt of a petition, the Secretary will either accept it for filing or reject it, and the petitioner will be so notified in writing. The Secretary will serve a copy of this notification on each other party served by the petitioner. Only such petitions which conform to the requirements of this subpart and which contain sufficient information for the purposes of a substantive decision will be accepted for filing. Petitions which do not so conform will be rejected and an explanation provided to petitioner in writing.

(2) For purposes of the Act and this subpart, a petition is deemed to be filed on the date it is accepted for filing.

(g) *Docket.* A petition accepted for filing will be assigned an appropriate docket designation. Petitioner shall use the docket designation in all subsequent submissions.

430.43 Notice of petition.

(a) Promptly after receipt of a peti-
ion and its acceptance for filing,
otice of such petition shall be pub-
ished in the FEDERAL REGISTER. The
otice shall set forth the availability
or public review of all data and infor-
ation available, and shall solicit com-
ents, data and information with re-
pect to the determination on the peti-
ion. Except as may otherwise be spec-
fied, the period for public comment
hall be 60 days after the notice ap-
ears in the FEDERAL REGISTER.

(b) In addition to the material re-
uired under paragraph (a) of this sec-
ion, each notice shall contain a sum-
ary of the State regulation at issue
nd the petitioner's reasons for the
ule sought.

430.44 Consolidation.

DOE may consolidate any or all mat-
ers at issue in two or more proceed-
ngs docketed where there exist
ommon parties, common questions of
act and law, and where such consoli-
ation would expedite or simplify con-
ideration of the issues. Consolidation
hall not affect the right of any party
o raise issues that could have been
aised if consolidation had not oc-
urred.

430.45 Hearing.

The Secretary may hold a public
earing, and publish notice in the FED-
RAL REGISTER of the date and location
f the hearing, when he determines
hat such a hearing is necessary and
ikely to result in a timely and effec-
ive resolution of the issues. A tran-
cript shall be kept of any such hear-
ng.

430.46 Disposition of petitions.

(a) After the submission of public
omments under § 430.42(a), the Secre-
ary shall prescribe a final rule or
eny the petition within 6 months
fter the date the petition is filed.

(b) The final rule issued by the Sec-
retary or a determination by the Sec-
retary to deny the petition shall in-
clude a written statement setting
forth his findings and conclusions, and
the reasons and basis therefor. A copy
of the Secretary's decision shall be
sent to the petitioner and the affected State agency. The Secretary shall publish in the FEDERAL REGISTER a notice of the final rule granting or denying the petition and the reasons and basis therefor.

(c) If the Secretary finds that he cannot issue a final rule within the 6-month period pursuant to paragraph (a) of this section, he shall publish a notice in the FEDERAL REGISTER extending such period to a date certain, but no longer than one year after the date on which the petition was filed. Such notice shall include the reasons for the delay.

§ 430.47 Effective dates of final rules.

(a) A final rule exempting a State standard from Federal preemption will be effective:

(1) Upon publication in the FEDERAL REGISTER if the Secretary determines that such rule is needed to meet an "energy emergency condition" within the State.

(2) Three years after such rule is published in the FEDERAL REGISTER; or

(3) Five years after such rule is published in the FEDERAL REGISTER if the Secretary determines that such additional time is necessary due to the burdens of retooling, redesign or distribution.

(b) A final rule withdrawing a rule exempting a State standard will be effective upon publication in the FEDERAL REGISTER.

§ 430.48 Request for reconsideration.

(a) Any petitioner whose petition for a rule has been denied may request reconsideration within 30 days of denial. The request shall contain a statement of facts and reasons supporting reconsideration and shall be submitted in writing to the Secretary.

(b) The denial of a petition will be reconsidered only where it is alleged and demonstrated that the denial was based on error in law or fact and that evidence of the error is found in the record of the proceedings.

(c) If the Secretary fails to take action on the request for reconsideration within 30 days, the request is deemed denied, and the petitioner may seek such judicial review as may be appropriate and available.

(d) A petitioner has not exhausted other administrative remedies until a request for reconsideration has been filed and acted upon or deemed denied.

§ 430.49 Finality of decision.

(a) A decision to prescribe a rule that a State energy conservation standard or other requirement not be preempted is final on the date the rule is issued, i.e., signed by the Secretary. A decision to prescribe such a rule has no effect on other regulations of a covered product of any other State.

(b) A decision to prescribe a rule withdrawing a rule exempting a State standard or other requirement is final on the date the rule is issued, i.e., signed by the Secretary. A decision to deny such a petition is final on the day a denial of a request for reconsideration is issued, i.e., signed by the Secretary.

Subpart E—Small Business Exemptions

SOURCE: 54 FR 6080, Feb. 7, 1989, unless otherwise noted.

§ 430.50 Purpose and scope.

(a) This subpart establishes procedures for the submission and disposition of applications filed by manufacturers of covered consumer products with annual gross revenues that do not exceed $8 million to exempt them temporarily from all or part of energy conservation standards established by this part.

(b) The purpose of this subpart is to provide content and format requirements for manufacturers of covered consumer products with low annual gross revenues who desire to apply for temporary exemptions from applicable energy conservation standards.

§430.51 Eligibility.

Any manufacturer of a covered product with annual gross revenues that do not exceed $8,000,000 from all its operations (including the manufacture and sale of covered products) for the 12-month period preceding the date of application may apply for an exemption. In determining the annual gross revenues of any manufacturer under
this subpart, the annual gross reve
of any other person who controls,
controlled, by, or is under comm
control with, such manufacturer sh
be taken into account.

§ 430.52 Requirements for applicatio

(a) Each application filed under th
subpart shall be submitted in tripl
cate to: U.S. Department of Energ
Small Business Exemptions, Applian
Efficiency Standards, Assistant Secr
tary for Conservation and Renewab
Energy, Forrestal Building, 1000 Ind
pendence Avenue, SW., Washingto
DC 20585.

(b) An application shall be in writi
and shall include the following:

(1) Name and mailing address of a
plicant;

(2) Whether the applicant contro
is controlled by, or is under comm
control with another manufactur
and if so, the nature of that control r
lationship;

(3) The text or substance of th
standard or portion thereof for whic
the exemption is sought and th
length of time desired for the exem
tion;

(4) Information showing the annu
gross revenue of the applicant for th
preceding 12-month period from all o
its operations (including the manufa
ture and sale of covered products);

(5) Information to show that failu
to grant an exemption is likely t
result in a lessening of competition;

(6) Such other information, if an
believed to be pertinent by the pe
tioner; and

(7) Such other information as th
Secretary may require.

§ 430.53 Processing of applications.

(a) The applicant shall serve a cop
of the application, all supporting doc
ments and all subsequent submissio
or a copy from which confidential i
formation has been deleted pursua
to 10 CFR 1004.11, to the Secretar
which may be made available f
public review.

(b) Within fifteen (15) days of th
receipt of an application, the Secr
tary will either accept it for filing o
reject it, and the applicant will be
notified in writing. Only such applic

tions which conform to the requirements of this subpart and which contain sufficient information for the purposes of a substantive decision will be accepted for filing. Applications which do not so conform will be rejected and an explanation provided to the applicant in writing.

(c) For the purpose of this subpart, an application is deemed to be filed on the date it is accepted for filing.

(d) Promptly after receipt of an application and its acceptance for filing, notice of such application shall be published in the FEDERAL REGISTER. The notice shall set forth the availability for public review of data and information available, and shall solicit comments, data and information with respect to the determination on the application. Except as may otherwise be specified, the period for public comment shall be 60 days after the notice appears in the FEDERAL REGISTER.

(e) The Secretary on his own initiative may convene a hearing if, in his discretion, he considers such hearing will advance his evaluation of the application.

§ 430.54 Referral to the Attorney General.

Notice of the application for exemption under this subpart shall be transmitted to the Attorney General by the Secretary and shall contain (a) a statement of the facts and of the reasons for the exemption, and (b) copies of all documents submitted.

§ 430.55 Evaluation of application.

The Secretary shall grant an application for exemption submitted under this subpart if the Secretary finds, after obtaining the written views of the Attorney General, that a failure to allow an exemption would likely result in a lessening of competition.

§ 430.56 Decision and order.

(a) Upon consideration of the application and other relevant information received or obtained, the Secretary shall issue an order granting or denying the application.

(b) The order shall include a written statement setting forth the relevant facts and the legal basis of the order.

(c) The Secretary shall serve a copy of the order upon the applicant and upon any other person readily identifiable by the Secretary as one who is interested in or aggrieved by such order. The Secretary also shall publish in the FEDERAL REGISTER a notice of the grant or denial of the order and the reason therefor.

§ 430.57 Duration of temporary exemption.

A temporary exemption terminates according to its terms but not later than twenty-four months after the affective date of the rule for which the exemption is allowed.

Subpart F—Certification and Enforcement

SOURCE: 54 FR 6081, Feb. 7, 1989, unless otherwise noted.

§ 430.60 Purpose and scope.

The regulations in this subpart set forth the procedures to be followed for certification and enforcement testing to determine whether a basic model of a covered product complies with the applicable energy conservation standard set forth in Subpart C of this Part. Energy conservation standards include minimum levels of efficiency and maximum levels of consumption (also referred to as performance standards) and prescriptive energy design requirements (also referred to as design standards).

§ 430.61 Prohibited acts.

(a) Each of the following is a prohibited act pursuant to section 332 of the Act:

(1) Failure to permit access to, or copying of records required to be supplied under the Act and this rule or failure to make reports or provide other information required to be supplied under this Act and this rule;

(2) Failure of a manufacturer to supply at his expense a reasonable number of covered products to a test laboratory designated by the Secretary;

(3) Failure of a manufacturer to permit a representative designated by the Secretary to observe any testing required by the Act and this rule and inspect the results of such testing; and

(4) Distribution in commerce by a manufacturer or private labeler of any new covered product which is not in compliance with an applicable energy efficiency standard prescribed under the Act and this rule.

(b) In accordance with section 333 of the Act, any person who knowingly violates any provision of paragraph (a) of this section may be subject to assessment of a civil penalty of no more than $100 for each violation. Each violation of paragraph (a) of this section shall constitute a separate violation with respect to each covered product, and each day of noncompliance with paragraphs (a) (1) through (3) of this section shall constitute a separate violation.

§ 430.62 Submission of data.

(a) Compliance statement and certification report. Each manufacturer or private labeler before distributing in commerce any basic model of a covered product subject to the applicable energy conservation standard set forth in Subpart C of this Part shall certify by means of a statement of compliance and certification report, that each basic model meets the requirements of that standard.

(1) The compliance statement shall certify that:

(i) The basic model(s) comply with the applicable energy conservation standards;

(ii) All required testing on which the compliance statement is based was conducted in conformance with the applicable test requirements prescribed in 10 CFR Part 430 Subpart B and this subpart and all test data are reported in accordance with this subpart;

(iii) All information reported in the compliance statement is true, accurate, and complete; and

(iv) The manufacturer (private labeler) is aware of the penalties associated with violations of the Act and the regulations thereunder, and 18 U.S.C. 1001 which prohibits knowingly making false statements to the Federal Government. The format for a compliance statement is set forth in Appendix A of this subpart.

(2) For each basic model the certification report shall include the annual energy use and adjusted volume (for refrigerators, refrigerator-freezers and freezers), energy factor and rated storage volume (for water heaters), the energy efficiency ratio (for room air conditioners), seasonal energy efficiency ratio and heating seasonal performance factor (for central air conditioners and central air conditioning heat pumps), thermal efficiency (for pool heaters), and annual fuel utilization efficiency (for furnaces and direct heating equipment) the model numbers for each basic model; and its capacity.

(3) Copies of reports to the Federal Trade Commission which include the information in paragraph (a)(2) of this section meet the requirements of this paragraph.

(b) Initial reporting requirements.

All data required by paragraph (a) of this section shall be submitted on or before the effective date of the applicable energy conservation standard as prescribed in section 325 of the Act. For each basic model of a covered product to be distributed in commerce, each manufacturer and private labeler or his representative shall file a compliance statement and certification report, by certified mail, to Department of Energy, Appliance Efficiency Standards, Assistant Secretary for Conservation and Renewable Energy, Forrestal Building, 1000 Independence Avenue, SW., Washington, DC 20585.

(c) *New models.* All information required by paragraph (a)(2) of this section must be submitted for new models prior to or concurrent with any distribution of such model. Any change to a basic model which affects energy consumption may constitute the addition of a new basic model subject to the requirements of § 430.61 of this part. If such change does not alter compliance with the applicable energy conservation standard for the basic model, the new model shall be considered certified. Models which are discontinued shall be reported, in writing, to the Department of Energy.

(d) ***Maintenance of records.*** (1) The manufacturer of any covered product subject to any of the energy performance standards or procedures prescribed in this part, shall establish maintain, and retain the records of the underlying test data for all certification testing. Such records shall be organized and indexed in a fashion which makes them readily accessible for review. The records should include the supporting test data associated with tests performed on any test units to satisfy the requirements of this subpart (except tests performed by DOE directly).

(2) All such records shall be retained by the manufacturer for a period of two years from the date that production of the applicable model has ceased. Records shall be retained in a form allowing ready access to DOE upon request.

(e) *Third party representation.* If a manufacturer or private labeler elects to use a third party, e.g., trade association or other authorized representative, to submit the certification report, the certification report shall include all the information identified in paragraph (a) of this section, including the compliance statement.

§ 430.63 Sampling.

(a) For purposes of a certification of compliance, the determination that a basic model complies with the applicable energy performance standard shall be based upon the sampling procedures set forth in § 430.23 of this Part. For purposes of a certification of compliance, the determination that a basic model complies with the applicable design standard shall be based upon the incorporation of specific design requirements for clothes dryers, dishwashers, clothes washers and kitchen ranges and ovens specified in section 325 of the Act.

(b) A basic model which meets the following requirements may qualify as an "other than tested model" for purposes of the certification testing and sampling requirements:

(1) Central air conditioners: The condenser-evaporator coil combinations manufactured by the condensing unit manufacturer other than the combination likely to have the largest volume of retail sales or the condenser-coil combinations manufactured in part by a component manufacturer using the same condensing unit.

(2) For purposes of certification of "other than tested models," as defined in paragraph (b)(1) of this section, a manufacturer may certify the basic model on the basis of computer simulation or engineering analysis as set forth in § 430.23(m) of this Part.

§ 430.64 Imported products.

(a) Pursuant to section 331 of the Act, any person importing any covered product into the United States shall comply with the provisions of the Act and of this Part, and is subject to the remedies of this Part.

(b) Any covered product offered for importation in violation of the Act and of this Part shall be refused admission into the customs territory of the United States under rules issued by the Secretary of the Treasury, except that the Secretary of the Treasury may, by such rules, authorize the importation of such covered product upon such terms and conditions (including the furnishing of a bond) as may appear to the Secretary of Treasury appropriate to ensure that such covered product will not violate the Act and this Part, or will be exported or abandoned to the United States.

§ 430.65 Exported products.

Pursuant to section 330 of the Act, this part shall not apply to any covered product if (a) such covered product is manufactured, sold, or held for sale for export from the United States (or such product was imported for export), unless such product is, in fact, distributed in commerce for use in the United States, and (b) such covered product, when distributed in commerce, or any container in which it is enclosed when so distributed, bears a stamp or label stating that such covered product is intended for export.

§ 430.70 Enforcement.

(a) *Performance standard*—(1) *Test notice.* Upon receiving information in writing, concerning the energy performance of a particular covered product sold by a particular manufacturer or private labeler which indicates that the covered product may not be in compliance with the applicable energy performance standard, the Secretary may conduct testing of that covered product under this subpart by means of a test notice addressed to the manufacturer in accordance with the following requirements:

(i) Such a procedure will only be followed after the Secretary or his designated representative has examined the underlying test data provided by the manufacturer and after the manufacturer has been offered the opportunity to meet with DOE to verify compliance with the applicable performance standard. A representative designated by the Secretary shall be permitted to observe any reverification procedures by this subpart, and to inspect the results of such reverification.

(ii) The test notice will be signed by the Secretary or his designee. The test notice will be mailed or delivered by DOE to the plant manager or other responsible official, as designated by the manufacturer.

(iii) The test notice will specify the model or basic model to be selected for testing, the method of selecting the test sample, the time at which testing shall be initiated, the date by which testing is scheduled to be completed and the facility at which testing will be conducted. The test notice may also provide for situations in which the selected basic model is unavailable for testing, and may include alternative basic models.

(iv) The Secretary may require in the test notice that the manufacturer of a covered product shall ship at his expense a reasonable number of units of a basic model specified in such test notice to a testing laboratory designated by the Secretary. The number of units of a basic model specified in a test notice shall not exceed twenty (20).

(v) Within 5 working days of the time units are selected, the manufacturer shall ship the specified test units of a basic model to the testing laboratory.

(2) *Testing Laboratory.* Whenever DOE conducts enforcement testing at a designated laboratory in accordance with a test notice under this section, the resulting test data shall constitute official test data for that basic model. Such test data will be used by DOE to make a determination of compliance or noncompliance if a sufficie number of tests have been conducte to satisfy the requirements of Appe dix B of this subpart.

(3) *Sampling.* The determinatio that a manufacturer's basic mode complies with the applicable energ performance standard shall be base on the testing conducted in accord ance with the statistical sampling procedures set forth in Appendix B o this subpart and the test procedure set forth in Subpart B of this Part.

(4) *Test unit selection.* A DOE inspector shall select a batch, a batch sample, and test units from the batch sample in accordance with the provisions of this paragraph and the conditions specified in the test notice.

(i) The batch may be subdivided by DOE utilizing criteria specified in the test notice, e.g., date of manufacture component-supplier, location of manufacturing facility, or other criteri which may differentiate one unit from another within a basic model.

(ii) A batch sample of up to 20 units will then be randomly selected from one or more subdivided groups within the batch. The manufacturer shall keep on hand all units in the batch sample until such time as the basic model is determined to be in compliance or noncompliance.

(iii) Individual test units comprising the test sample shall be randomly selected from the batch sample.

(iv) All random selection shall be achieved by sequentially numbering all of the units in a batch sample and then using a table of random numbers to select the units to be tested.

(5) *Test unit preparation.* (i) Prior to and during testing, a test unit selected in accordance with paragraph (a)(4) of this section shall not be prepared modified, or adjusted in any manner unless such preparation, modification or adjustment is allowed by the applicable DOE test procedure. One test shall be conducted for each test unit in accordance with the applicable test procedures prescribed in Subpart B.

(ii) No quality control, testing or assembly procedures shall be performed on a test unit, or any parts and subassemblies thereof, that is not performed during the production and sembly of all other units included in the basic model.

(iii) A test unit shall be considered defective if such unit is inoperative or is found to be in noncompliance due to failure of the unit to operate according to the manufacturer's design and operating instructions. Defective units, including those damaged due to shipping or handling, shall be reported immediately to DOE. DOE shall authorize testing of an additional unit on a case-by-case basis.

(6) *Testing at manufacturer's option.* (i) If a manufacturer's basic model is determined to be in noncompliance with the applicable energy performance standard at the conclusion of DOE testing in accordance with the double sampling plan specified in Appendix B of this subpart, the manufacturer may request that DOE conduct additional testing of the model according to procedures set forth in Appendix B of this subpart.

(ii) All units tested under paragraph (a)(6) of this section shall be selected and tested in accordance with the provisions given in paragraphs (a) (1) through (5) of this section.

(iii) The manufacturer shall bear the cost of all testing conducted under paragraph (a)(6) of this section.

(iv) The manufacturer shall cease distribution of the basic model being tested under the provisions of paragraph (a)(6) of this section from the time the manufacturer elects to exercise the option provided in this paragraph until the basic model is determined to be in compliance. DOE may seek civil penalties for all units distributed during such period.

(v) If the additional testing results in a determination of compliance, a notice of allowance to resume distribution shall be issued by the Department.

(b) *Design standard.* In the case of a design standard, a model is determined noncompliant by DOE after the Secretary or his designated representative has examined the underlying design information provided by the manufacturer and after the manufacturer has been offered the opportunity to verify compliance with the applicable design standard.

§ 430.71 Cessation of distribution of a basic model.

(a) In the event that a model is determined noncompliant by DOE in accordance with § 430.70 of this Part or if a manufacturer or private labeler determines a model to be in noncompliance, then the manufacturer or private labeler shall:

(1) Immediately cease distribution in commerce of the basic model;

(2) Give immediate written notification of the determination of noncompliance, to all persons to whom the manufacturer has distributed units of the basic model manufactured since the date of the last determination of compliance.

(3) Pursuant to a request made by the Secretary, provide DOE within 30 days of the request, records, reports and other documentation pertaining to the acquisition, ordering, storage, shipment, or sale of a basic model determined to be in noncompliance.

(4) The manufacturer may modify the noncompliant basic model in such manner as to make it comply with the applicable performance standard. Such modified basic model shall then be treated as a new basic model and must be certified in accordance with the provisions of this subpart; except that in addition satisfying all requirements of this subpart, the manufacturer shall also maintain records that demonstrate that modifications have been made to all units of the new basic model prior to distribution in commerce.

(b) If a basic model is not properly certified in accordance with the requirements of this subpart, the Secretary may seek, among other remedies, injunctive action to prohibit distribution in commerce of such basic model.

§ 430.72 Subpoena.

Pursuant to section 329(a) of the Act, for purposes of carrying out this part, the Secretary or the Secretary's designee, may sign and issue subpoenas for the attendance and testimony of witnesses and the production of relevant books, records, papers, and other documents, and administer the oaths. Witnesses summoned under the provisions of this section shall be paid the same fees and mileage as are paid to witnesses in the courts of the United States. In case of contumacy by, or refusal to obey a subpoena served, upon any persons subject to this Part, the Secretary may seek an order from the District Court of the United States for any District in which such person is found or resides or transacts business requiring such person to appear and give testimony, or to appear and produce documents. Failure to obey such order is punishable by such court as a contempt thereof.

§ 430.73 Remedies.

If DOE determines that a basic model of a covered product does not comply with an applicable energy conservation standard:

(a) DOE will notify the manufacturer, private labeler or any other person as required, of this finding and of the Secretary's intent to seek a judicial order restraining further distribution in commerce of such basic model unless the manufacturer, private labeler or any other person as required, delivers to DOE within 15 calendar days a statement, satisfactory to DOE, of the steps he will take to insure that the noncompliant model will no longer be distributed in commerce. DOE will monitor the implementation of such statement.

(b) If the manufacturer, private labeler or any other person as required, fails to stop distribution of the noncompliant model, the Secretary may seek to restrain such violation in accordance with section 334 of the Act.

(c) The Secretary shall determine whether the facts of the case warrant the assessment of civil penalties for knowing violations in accordance with section 333 of the Act.

§ 430.74 Hearings and appeals.

(a) Pursuant to section 333(d) of the Act, before issuing an order assessing a civil penalty against any person under this section, the Secretary shall provide to such person notice of the proposed penalty. Such notice shall inform such person of that person's opportunity to elect in writing within 30 days after the date of receipt of such notice to have the procedures of paragraph (c) of this section (in lieu of those in paragraph (b) of this section) apply with respect to such assessment.

(b)(1) Unless an election is made within 30 calendar days after receipt of notice under paragraph (a) of this section to have paragraph (c) of this section apply with respect to such penalty, the Secretary shall assess the penalty, by order, after a determination of violation has been made on the record after an opportunity for an agency hearing pursuant to section 554 of Title 5, United States Code before an administrative law judge appointed under section 3105 of such Title 5. Such assessment order shall include the administrative law judge's findings and the basis for such assessment.

(2) Any person against whom a penalty is assessed under this section may, within 60 calendar days after the date of the order of the Secretary assessing such penalty, institute an action in the United States Court of Appeals for the appropriate judicial circuit for judicial review of such order in accordance with Chapter 7 of Title 5, United States Code. The court shall have jurisdiction to enter a judgment affirming, modifying, or setting aside in whole or in part, the order of the Secretary, or the court may remand the proceeding to the Secretary for such further action as the court may direct.

(c)(1) In the case of any civil penalty with respect to which the procedures of this section have been elected, the Secretary shall promptly assess such penalty, by order, after the date of the receipt of the notice under paragraph (a) of this section of the proposed penalty.

(2) If the civil penalty has not been paid within 60 calendar days after the assessment has been made under paragraph (c)(1) of this section, the Secretary shall institute an action in the appropriate District Court of the United States for an order affirming the assessment of the civil penalty. The court shall have authority to review de novo the law and the facts involved and shall have jurisdiction to enter a judgment enforcing, modifying, and enforcing as so modified, or setting aside in whole or in part, such assessment.

(3) Any election to have this paragraph apply may not be revoked except with the consent of the Secretary.

(d) If any person fails to pay an assessment of a civil penalty after it has become a final and unappealable order under paragraph (b) of this section, or after the appropriate District Court has entered final judgment in favor of the Secretary under paragraph (c) of this section, the Secretary shall institute an action to recover the amount of such penalty in any appropriate District Court of the United States. In such action, the validity and appropriateness of such final assessment order or judgment shall not be subject to review.

(e)(1) In accordance with the provisions of section 333(d)(5)(A) of the Act and notwithstanding the provisions of title 28, United States Code, or section 402(c) of the Department of Energy Organization Act, the Secretary shall be represented by the General Counsel of the Department of Energy (or any attorney or attorneys within DOE designated by the Secretary) who shall supervise, conduct, and argue any civil litigation to which paragraph (c) of this section applies including any related collection action under paragraph (d) of this section in a court of the United States or in any other court, except the Supreme Court of the United States. However, the Secretary or the General Counsel shall consult with the Attorney General concerning such litigation and the Attorney General shall provide, on request, such assistance in the conduct of such litigation as may be appropriate.

(2) In accordance with the provisions of section 333(d)(5)(B) of the Act, and subject to the provisions of section 402(c) of the Department of Energy Organization Act, the Secretary shall be represented by the Attorney General, or the Solicitor General, as appropriate, in actions under this section, except to the extent provided in paragraph (e)(1) of this section.

(3) In accordance with the provisions of section 333(d)(5)(C) of the Act, section 402(d) of the Department of Energy Organization Act shall not apply with respect to the function of the Secretary under this section.

§ 430.75 Confidentiality.

Pursuant to the provisions of 10 CFR 1004.11, any person submitting information or data which the person believes to be confidential and exempt law from public disclosure should submit one complete copy, and fifteen copies from which the information believed to be confidential has been deleted. In accordance with the procedures established at 10 CFR 1004.11, DOE shall make its own determination with regard to any claim that information submitted be exempt from public disclosure.

OMB Control No. 1910-1400

APPENDIX A TO SUBPART F COMPLIANCE STATEMENT

Statement of Compliance With Energy Conservation Standards for Appliances

Product: ________________________

Manufacturer's Name and Address

____

____

____

Date: ________________________

Submit by Certified Mail to: Department of Energy, Appliance Efficiency Standards, Assistant Secretary for Conservation and Renewable Energy, Forrestal Building, 1000 Independence Avenue, SW., Washington, DC 20585.

This report is submitted pursuant to Part 430 (Energy Conservation Program for Consumer Products) of the Energy Policy and Conservation Act (Pub. L. 94-163), and amendments thereto. The basic model(s) included in this report complies (comply) with the applicable energy conservation standard. All testing where appropriate, on which this certification report is based, was conducted in conformance with the applicable test requirements prescribed in Subpart B of 10 CFR Part 430. All information reported in this certification report is true, accurate, and complete. I am aware of the penalties associated with violations of the Act and the regulations thereunder, and am also aware of the provisions contained in 18 U.S.C. 1001, which prohibits knowingly making false statements to the Federal Government.

Name of Person to Contact for Further Information:

Name: ________________________

Address: ________________________

Telephone No.: ________________________

If the model specific information accompanying this statement of compliance was prepared by a third party organization under the provisions of § 430.62 of 10 CFR

Part 430, the individual (manufacturer) authorizing third party representations:

Signature: ____________________

Name: ____________________

Address: ____________________

Telephone No.: ____________________

APPENDIX B TO SUBPART F OF PART 430—SAMPLING PLAN FOR ENFORCEMENT TESTING

Double Sampling

Step 1. The first sample size (n_1) must be four or more units.

Step 2. Compute the mean ($\bar{x}_1$) of measured energy performance of the units in the first sample as follows:

$$\bar{x}_1 = \frac{1}{n_1}\left(\sum_{i=1}^{n_1} x_i\right)$$

where x_i is the measured energy efficiency or energy consumption of unit i.

Step 3. Compute the standard devia (s_1) of the measured energy performan the n_1 units in the first sample as follow

$$s_1 = \sqrt{\frac{\sum_{i=1}^{n_1} (x_i - \bar{x}_1)^2}{n_1 - 1}}$$

Step 4. Compute the standard error ($s_{\bar{x}_1}$) of the measured energy performance of the n_1 units in the first sample as follows:

$$s_{\bar{x}_1} = \frac{s_1}{\sqrt{n_1}}$$

Step 5. Compute the upper control limit (UCL_1) and lower control limit (LCL_1) for the mean of the first sample using the applicable DOE energy performance standard (EPS) as the desired mean and a probab level of 95 percent (two-tailed test) a lows:

$$LCL_1 = EPS - ts_{\bar{x}_1} \quad (4)$$

$$UCL_1 = EPS + ts_{\bar{x}_1} \quad (5)$$

where t is a statistic based on a 95 percent two-tailed probability level and a sample size of n_1.

Step 6A. For an Energy Efficiency Standard, compare the mean of the first sample ($\bar{x}_1$) with the upper and lower control limits (UCL_1 and LCL_1) to determine one of the following:

(i) If the mean of the first sample is below the lower control limit, then the basic model is in noncompliance and testing is at an end. (Do not go on to any of the steps below.)

(ii) If the mean of the first sample is equal to or greater than the upper control limit, then the basic model is in compliance and testing is at an end. (Do not go on to any of the steps below.)

(iii) If the sample mean is equal to or greater than the lower control limit but less than the upper control limit, then no determination of compliance or noncompliance can be made and a second sample size is determined by Step 7a.

Step 6b. For an Energy Consumption Standard, compare the mean of the first sample ($\bar{x}_1$) with the upper and lower control limits (UCL_1 and LCL_1) to determine one of the following:

(i) If the mean of the first sample is above the upper control limit, then the basic model is in noncompliance and testing is at an end. (Do not go on to any of the steps below.)

(ii) If the mean of the first sample is equal to or less than the lower control limit, then the basic model is in compliance and testing is at an end. (Do not go on to any of the steps below.)

(iii) If the sample mean is equal to or less than the upper control limit but greater than the lower control limit, then no determination of compliance or noncompliance can be made and a second sample size is determined by Step 7b.

Step 7a. For an Energy Efficiency Standard, determine the second sample size (n_2) as follows:

$$n_2 = \left(\frac{t\, s_1}{0.05\ EPS} \right)^2 - n_1 \quad (6a)$$

where s_1 and t have the values used in Steps 4 and 5, respectively. The term "0.05 EPS" is the difference between the applicable energy efficiency standard and 95 percent of the standard, where 95 percent of the standard is taken as the lower control limit. This procedure yields a sufficient combined sample size ($n_1 + n_2$) to give an estimated 97.5 percent probability of obtaining a determination of compliance when the true mean efficiency is equal to the applicable standard.

Given the solution value of n_2, determine one of the following:

(1) If the value of n_2 is less than or equal to zero *and* if the mean energy efficiency of the first sample ($\bar{x}_1$) is either equal to or greater than the lower control limit (LCL_1) or equal to or greater than 95 percent of the applicable energy efficiency standard (EES), whichever is greater, i.e., if

$n_2 \le 0$ *and* $\bar{x}_1 \ge \max(LCL_1, 0.95\ EES)$,

the basic model is in compliance and testing is at an end.

(2) If the value of n_2 is less than or equal to zero *and* the mean energy efficiency of the first sample ($\bar{x}_1$) is less than the lower control limit (LCL_1) or less than 95 percent of the applicable energy efficiency standard (EES), whichever is greater, i.e., if

$n_2 \le 0$ *and* $\bar{x}_1 < \max(LCL_1, 0.95\ EES)$,

the basic model is in noncompliance and testing is at an end.

(3) If the value of n_2 is greater than zero, then value of the second sample size is determined to be the smallest integer equal to or greater than the solution value of n_2 for equation (6a). If the value of n_2 so calculated is greater than $20-n_1$, set n_2 equal to $20-n_1$.

Step 7b. For an Energy Consumption Standard, determine the second sample size (n_2) as follows:

$$n_2 = \left(\frac{t\, s_1}{0.05\ EPS} \right)^2 - n_1 \quad (6b)$$

where s_1 and t have the values used in Steps 4 and 5, respectively. The term "0.05 EPS" is the difference between the applicable energy consumption standard and 105 percent of the standard, where 105 percent of the standard is taken as the upper control limit. This procedure yields a sufficient combined sample size ($n_1 + n_2$) to give an estimated 97.5 percent probability of obtaining a determination of compliance when the true mean consumption is equal to the applicable standard.

Given the solution value of n_2, determine one of the following:

(1) If the value of n_2 is less than or equal to zero *and* if the mean energy consumption of the first sample ($\bar{x}_1$) is either equal to or less than the upper control limit (UCL_1) or equal to or less than 105 percent of the applicable energy performance standard (EPS), whichever is less, i.e., if

$n_2 \leq 0$ *and* $\bar{x}_1 \geq \min(UCL_1, 1.05\ EPS)$,

the basic model is in compliance and testing is at an end.

(2) If the value of n_2 is less than or equal to zero *and* the mean energy consumption of the first sample ($\bar{x}_1$) is greater than the upper control limit (UCL_1) or more than 105 percent of the applicable energy performance standard (EPS), whichever is less, i.e., if

$n_2 \leq 0$ *and* $\bar{x}_1 \geq \min(LCL_1, 1.05\ EPS)$,

the basic model is in noncompliance and testing is at an end.

(3) If the value of n_2 is greater than zero, then the value of the second sample size is determined to be the smallest integer equal to or greater than the solution value of n_2 for equation (6b). If the value of n_2 so calculated is greater than $20-n_1$, set n_2 equal to $20-n_1$.

Step 8. Compute the combined mean ($\bar{x}_2$) of the measured energy performance of the n_1 and n_2 units of the combined first and second samples as follows:

$$\bar{x}_2 = \frac{1}{n_1 + n_2}\left(\sum_{i=1}^{n_1+n_2} x_i\right) \qquad (7)$$

Step 9. Compute the standard error ($s_{\bar{x}_2}$) of the measured energy performance of the n_1 and n_2 units in the combined first and second samples as follows:

$$s_{\bar{x}_2} = \frac{s_1}{\sqrt{n_1 + n_2}} \qquad (8)$$

NOTE.—s_1 is the value obtained in Step 3.

Step 10a. For an Energy Efficiency Standard, compute the lower control limit (LCL_2) for the mean of the combined first and second samples using the DOE energy efficiency standard (EES) as the desired mean and a one-tailed probability level of 97.5 percent (equivalent to the two-tailed probability level of 95 percent used in Step 5 above) as follows:

$$LCL_2 = EES - t\, s_{\bar{x}_2} \qquad (9a)$$

where the t-statistic has the value obtained in Step 5 above.

Step 10b. For an Energy Consumption Standard, compute the upper control limit (UCL_2) for the mean of the combined first and second samples using the DOE energy performance standard (EPS) as the desired mean and a one-tailed probability level of 102.5 percent (equivalent to the two-tailed probability level of 95 percent used in Step 5, above) as follows:

$$UCL_2 = EPS + t\, s_{\bar{x}_2} \qquad (9b)$$

where the t-statistic has the value obtained in Step 5 above.

Step 11a. For an Energy Efficiency Standard, compare the combined sample mean ($\bar{x}_2$) to the lower control limit (LCL_2) to find one of the following:

(i) If the mean of the combined sample ($\bar{x}_2$) is less than the lower control limit (LCL_2) or 95 percent of the applicable energy efficiency standard (EES), whichever is greater, i.e., if

$\bar{x}_2 \geq \max(LCL_2, 0.95\ EES)$,

the basic model is in noncompliance and testing is at an end.

(ii) If the mean of the combined sample ($\bar{x}_2$) is equal to or greater than the lower control limit (LCL_2) or 95 percent of the applicable energy efficiency standard (EES), whichever is greater, i.e., if

$\bar{x}_2 \geq \max(LCl_2, 0.95\ EES)$,

the basic model is in compliance and testing is at an end.

Step 11b. For an Energy Consumption Standard, compare the combined sample mean ($\bar{x}_2$) to the upper control limit (UCL_2) to find one of the following:

(i) If the mean of the combined sample ($\bar{x}_2$) is greater than the upper control limit (UCL_2) or 105 percent of the applicable energy performance standard (EPS), whichever is less, i.e., if

$\bar{x}_2 \geq \min(UCL_2, 1.05\ EPS)$,

the basic model is in noncompliance and testing is at an end.

(ii) If the mean of the combined sample ($\bar{x}_2$) is equal to or less than the upper control limit (UCL_2) or 105 percent of the applicable energy performance standard (EPS), whichever is less, i.e., if

$\bar{x}_2 \leq \min(UCL_2, 1.05\ EPS)$,

the basic model is in compliance and testing is at an end.

Manufacturer-Option Testing

If a determination of non-compliance is made in Steps 6, 7 or 11, above, the manufacturer may request that additional testing be conducted, in accordance with the following procedures.

Step A. The manufacturer requests that an additional number, n_3, of units be tested, with n_3 chosen such that $n_1+n_2+n_3$ does not exceed 20.

Step B. Compute the mean energy performance, standard error, and lower or upper control limit of the new combined sample in accordance with the procedures prescribed in Steps 8, 9, and 10, above.

Step C. Compare the mean performance of the new combined sample to the revised lower or upper control limit to determine one of the following:

a.1. For an Energy Efficiency Standard, if the new combined sample mean is equal to or greater than the lower control limit or 95 percent of the applicable energy efficiency standard, whichever is greater, the basic model is in compliance and testing is at an end.

a.2. For an Energy Consumption Standard, if the new combined sample mean is equal to or less than the upper control limit or 105 percent of the applicable energy consumption standard, whichever is less, the basic model is in compliance and testing is at an end.

b.1. For an Energy Efficiency Standard, if the new combined sample mean is less than the lower control limit or 95 percent of the applicable energy efficiency standard, whichever, is greater, and the value of $n_1+n_2+n_3$ is less than 20, the manufacturer may request that additional units be tested. The total of all units tested may not exceed 20. Steps A, B, and C are then repeated.

b.2. For an Energy Consumption Standard, if the new combined sample mean is greater than the upper control limit or 105 percent of the applicable energy consumption standard, whichever is less, and the value of $n_{1}+_{2}+_{3}$ is less than 20, the manufacturer may request that additional units be tested. The total of all units tested may not exceed 20. Steps A, B, and C are then repeated.

c. Otherwise, the basic model is determined to be in noncompliance.

[54 FR 6081, Feb. 7, 1989; 54 FR 11320, Mar. 17, 1989]

PART 435—ENERGY CONSERVATION VOLUNTARY PERFORMANCE STANDARDS FOR NEW BUILDINGS; MANDATORY FOR FEDERAL BUILDINGS

Subpart A—Voluntary Performance Standards for New Commercial and Multi-Family High Rise Residential Buildings; Mandatory for Federal Buildings

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435.108 Heating, ventilation, and air-conditioning (HVAC) equipment.
435.109 Service water heating systems.
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Subpart B—Voluntary Performance Standards for New Non-Federal Residential Buildings [Reserved]

Subpart C—Mandatory Performance Standards for New Federal Residential Buildings

435.300 Purpose.
435.301 Scope.
435.302 Definitions.
435.303 Requirements for the design of a Federal residential building.
435.304 The COSTSAFR Program.

AUTHORITY: Energy Conservation Standards for New Buildings Act of 1976, as amended, (42 U.S.C. 6831-6870), enacted as Title III of the Energy Conservation and Production Act; (42 U.S.C. 8201 *et seq.*); (42 U.S.C. 8255); section 545, National Energy Conservation Policy Act; Department of Energy Organization Act, (42 U.S.C. 7101 *et seq.*).

SOURCE: 53 FR 32545, Aug. 25, 1988, unless otherwise noted.

Subpart A—Voluntary Perform Standards for New Comm and Multi-Family High Rise Re dential Buildings; Mandatory f Federal Buildings

SOURCE: 54 FR 4554, January 30, 19 unless otherwise noted.

§ 435.97 Purpose.

(a) This subpart establishes ener conservation voluntary perform standards for the design of new co mercial and multi-family high rise re idential buildings. The voluntary pe formance standards are designed t achieve the maximum practicable im provements in energy efficiency a increases in the use of non-depleta sources of energy.

(b) The voluntary perform standards will be used by Fede agencies for the design of new Fede commercial and multi-family high ri residential buildings.

(c) Except in the case of new com mercial and multi-family high rise re idential buildings, which are Feder buildings, voluntary perform standards prescribed under this sub part are developed solely as guidelin for the purpose of providing technic assistance for the design of energy ef ficient buildings.

§ 435.98 Scope.

(a) The voluntary perform standards for new commercial a multi-family high rise residenti buildings apply to the design of a ne commercial or multi-family high ri residential building, except for the fo lowing:

(1) A building constructed and deve oped for residential occupancy, unle the building is a multi-family high ri residential building with 3 or more st ries;

(2) Heating, cooling, ventilating, o service hot water requirements f those spaces where processes occur f purposes other than occupant comfor and sanitation, and which impo thermal loads in excess of 5% of th loads that would otherwise be requir for occupant comfort and sanitatio without the process;

(3) Envelope requirements for those spaces where heating or cooling requirements are excepted in paragraph (a)(2) of this section;

(4) Lighting for tasks not listed or encompassed by areas or activities listed in Table 3.5-1; and

(5) Buildings that are composed entirely of spaces listed in paragraphs (a)(2), (3), and (4) of this section.

§ 435.99 General definitions and acronyms.

(a) For the purpose of this subpart:

"Accessible (as applied to equipment)" means admitting close approach; not guarded by locked doors, elevation, or other effective means. (See also *Readily Accessible.*)

"Adjusted Lighting Power" means lighting power, ascribed to a luminaire(s), that has been reduced by deducting a lighting power control credit based on use of an automatic control device.

"Annual Fuel Utilization Efficiency" means the ratio of annual output energy to annual input energy that includes any non-heating season pilot input loss.

"Air Conditioning, Comfort" means treating air to control its temperature, relative humidity, cleanliness, and distribution to meet the comfort requirements of the occupants of the conditioned space. Some air conditioners may not accomplish all of these controls.

"Ambient Lighting" means lighting that produces general illumination throughout an area.

"Area Factor" means a multiplying factor that adjusts the base unit power density (UPD) for spaces of various sizes to account for the impact of room configuration on lighting power utilization.

"Automatic" means a self-acting, operating by its own mechanism, when actuated by some impersonal influence, such as, a change in current strength, pressure, temperature or mechanical configuration. (See also *Manual.*)

"Ballast" means a device used with an electric-discharge lamp to obtain the necessary circuit conditions (voltage, current, and wave form) for starting and operating.

"Ballast Efficacy Factor—Fluorescent" means the ratio of the relative light output to the power input in watts, at specified test conditions, expressed as a percent.

"Ballast Factor" means the ratio of a commercial ballast lamp lumens to a reference ballast lamp lumens, used to correct the lamp lumen output from rated to actual.

"Boiler Capacity" means the rated heat output in Btu/h of the boiler, at the design inlet and outlet conditions and rated fuel/energy input.

"British Thermal Unit" means approximately the amount of heat required to raise the temperature of one pound of water from 59 °F to 60 °F.

"Building" means any new structure to be constructed that includes provision for a heating or cooling system, or both, or for a hot water system.

"Building Code" means a legal instrument which is in effect in a state or unit of general purpose local government, the provisions of which must be adhered to if a building is to be considered to be in conformance with law and suitable for occupancy and use.

"Building Design" means the architectural and engineering drawings and specifications used for the construction of a new building.

"Building Energy Cost" means the computed annual energy cost of all purchased energy for the building, calculated using the methods of Section 435.111 of these standards.

"Building Envelope" means the elements of a building that enclose conditioned spaces through which thermal energy may be transferred to or from the exterior or to or from unconditioned spaces.

"Building Type" means the classification of a building by usage. In this regulation the following classifications of buildings are defined by these uses:

(1) "Assembly" means a building or structure for the gathering together of persons, such as auditoriums, churches, dance halls, gymnasiums, theaters, museums, passenger depots, sports facilities, and public assembly halls.

(2) "Health and Institutional" means a building or structure for the purpose of providing medical treatment, confinement or care, and sleeping facilities such as hospitals, sanitar-

iums, clinics, orphanages, nursing homes, mental institutions, reformatories, jails, and prisons.

(3) "Hotel/Motel" means a building or structure for transient occupancy, such as resorts, hotels, motels, barracks, and dormitories.

(4) "Multi-Family" means a building or structure containing three or more dwelling units. (See *Dwelling Units*, and *Multi-Family Dwelling*.)

(5) "Office (Business)" means a building or structure for office, professional, or service type transactions, such as medical offices, banks, libraries, and business offices, including governmental office buildings.

(6) "Restaurant" means a building or a structure for the consumption of food or drink, including fast food, coffee shops, cafeterias, bars, and restaurants.

(7) "Retail (Mercantile)" means a building or a structure for the display and sale (wholesale or retail) of merchandise, such as shopping malls, food markets, auto dealerships, department stores, and specialty shops. (See also *Retail Establishments*.)

(8) "School (Educational)" means a building or structure for the purpose of instruction, such as schools, colleges, universities, and academies.

(9) "Warehouse (Storage)" means a building or structure for storage, such as aircraft hangers, garages, warehouses, storage buildings, and freight depots.

"Check Metering" means measurement instrumentation for the supplementary monitoring of energy (electric, gas, oil, etc.) consumption, in addition to the revenue metering furnished by the utility, to isolate the various categories of energy use to permit conservation and control.

"Coefficient of Performance—Cooling" means the ratio of the rate of heat removal to the rate of energy input in consistent units, for a complete cooling system or factory assembled equipment, as tested under a nationally recognized standard or designated operating conditions.

"Coefficient of Performance, Heat Pump—Heating" means the ratio of the rate of heat delivered to the rate of energy input, in consistent units, for a complete heat pump system under designated operating condition When checking compliance with th heat pump equipment COP's listed i the tables in Section 435.108.

"Combined Thermal Transmittanc Values" (See *Thermal Transmittanc Overall.*)

"Commercial Building" means building other than a residential buil ing, including any building develope for industrial or public purposes.

"Conditioned Floor Area" means th area of the conditioned space mea ured at floor level from the interi surfaces of the walls.

"Conditioned Space" means volume within a building that is de signed to be heated and/or cooled, d rectly or indirectly.

"Connected Lighting Power" mean the power required to energize lumin aires and lamps installed and connec ed to the building electrical service, i watts.

"Control Loop, Local" means a co trol system consisting of a sensor, controller, and a controlled device.

"Cooled Space" means an enclose area within a building that has a r frigeration system whose sensible c pacity exceeds 5 Btu/h·ft² or is capa ble of maintaining space dry bulb tem peratures of 90 °F or less at desig cooling conditions.

"Daylight Sensing Control" means device that automatically regulate the power input to electric lightin near the fenestration to maintain th desired workplace illumination, thu taking advantage of direct or indirec sunlight.

"Dead Band (Dead Zone)" mean the range of values within which a input variable can be varied withou initiating any noticeable change in th output variable.

"Default Assumption" means th value of an input used in a calculatio procedure when a value is not entere by the designer.

"Degree-Day" means a unit, base upon temperature difference and tim used in estimating fuel consumptio and specifying nominal heating load o building in winter. For any day, whe the mean temperature is less than reference temperature, typically 65 °F there are as many Degree-Days a Fahrenheit degrees difference in tem perature between the mean temperature for the day and the reference temperature.

"Degree Day, Cooling" means a unit, based upon temperature difference and time, used in estimating cooling energy consumption. For any one day, when the mean temperature is more than a reference temperature, typically 65 °F, there are as many Degree Days as degrees Fahrenheit temperature difference between the mean temperature for the day and the reference temperature. Annual Cooling Degree Days (CDD) are the sum of the degree days over a calendar year.

"Degree Day, Heating" means a unit, based upon temperature difference and time, used in estimating heating energy consumption. For any one day, when the mean temperature is less than a reference temperature, typically 65 °F, there are as many Degree Days as degrees Fahrenheit temperature difference between the mean temperature for the day and the reference temperature. Annual Heating Degree Days (HDD) are the sum of the degree days over a calendar year.

"Demand (Electric)" means the rate at which electric energy is delivered to or by a system, part of a system, or a piece of equipment; expressed in kilowatts, kilovoltamperes; or other suitable units at a given instant or averaged over any designated period.

"Design Conditions" means the exterior and interior environmental parameters specified for air conditioning and electrical design for a facility.

"Design Energy Consumption" means the computed annual energy usage of a proposed building design.

"Design Energy Costs" means the computed annual energy expenditures of a proposed building design.

"Dwelling Unit" means a single housekeeping unit comprised of one or more rooms providing complete, independent living facilities for one or more persons including permanent provisions for living, sleeping, eating, cooking, and sanitation.

"Economizer, Air" means a ducting arrangement and automatic control system that allows a cooling supply fan system to supply outside air to reduce or eliminate the need for mechanical refrigeration during mild or cold weather.

"Economizer, Water" means a system by which the supply air of a cooling system is cooled directly and/or indirectly by evaporation of water, or by other appropriate fluid, in order to reduce or eliminate the need for mechanical refrigeration.

"Efficiency, HVAC System" means the ratio of the useful energy output (at the point of use) to the energy input in consistent units for a designated time period, expressed in percent.

"Emergency System (Back Up System)" means a system which exists for the purpose of operating in the event of failure of a primary system.

"Energy" means the capability for doing work; having several forms that may be transformed from one to another, such as thermal (heat), mechanical (work), electrical, and chemical.

"Energy Cost" means the annual cost of energy by unit and type of energy.

"Energy Cost Budget" means the maximum allowable computed annual energy expenditure for a proposed building.

"Energy Efficiency Ratio" means the ratio of net equipment cooling capacity in Btu/h to total rate of electric input in watts under designated operating conditions. When consistent units are used, this ratio becomes equal to COP. (See also *Coefficient of Performance.*)

"Energy Management System" means a control system designed to monitor the environment and the use of energy in a facility and to adjust the parameters of local control loops to conserve energy while maintaining a suitable environment.

"Energy, Recovered" (See *Recovered Energy.*)

"Enthalpy" means a thermodynamic property of a substance defined as the sum of its internal energy plus the quantity PV/J, where P=pressure of the substance, V=its volume, and J=the mechanical equivalent of heat; formerly called total heat and heat content.

"Exterior Envelope" (See *Building Envelope.*)

"Fenestration" means any light-transmitting section in a building wall or roof. The fenestration includes glazing material, which may be glass or plastic; framing, mullions, muntins, and dividers; external shading devices; internal shading devices, and integral (between-glass) shading devices.

"Federal Agency" means any department, agency, corporation, or other entity or instrumentality of the executive branch of the Federal Government, including the United States Postal Service, the Federal National Mortgage Association, and the Federal Home Loan Mortgage Corporation.

"Federal Building" means any building to be constructed by, or for the use of, any Federal Agency which is not legally subject to State or local building codes or similar requirements.

"Footcandle" means the unit of illuminance on a surface one square foot in area on which there is a uniformly distributed flux of one lumen, or the illuminance produced on a surface all points of which are at a distance of one foot from a directionally uniform point source of one candela.

"General Lighting" means lighting designed to provide illumination throughout an area, exclusive of any provision for special local requirements.

"Gross Floor Area" means the sum of the areas of the several floors of the building, including basements, mezzanine and intermediate-floored tiers and penthouses of headroom height, measured from the exterior faces of exterior walls or from the centerline of walls separating buildings, but excluding covered walkways, open roofed-over areas, porches and similar spaces, pipe trenches, exterior terraces or steps, chimneys, roof overhangs, and similar features.

"Gross Lighted Area" means the sum of the total lighted areas of a building measured from the inside of the perimeter walls, for each floor of the building.

"Gross Roof Area" means the total surface of the roof assembly exposed to the outside air, including all roof/ceiling and skylight components through which heat may flow between indoor and outdoor environments, excluding service openings.

"Gross Exterior Wall Area" means the total surface of the wall assembly exposed to the outside air and enclosing a heated or cooled space consisting of opaque surfaces, including between floor spandrels, peripheral edges of flooring and window areas including sash and door areas but excluding vents, grilles, and pipes.

"HVAC System" means the equipment distribution network and terminals that provide either collectively or individually the processes of heating, ventilating, and/or air conditioning to a building.

"HVAC System Efficiency" (See *Efficiency, HVAC System.*)

"Heat" means the form of energy that is transferred by virtue of a temperature difference or a change in state of a material.

"Heat Capacity" means the amount of heat necessary to raise the temperature of a given mass one degree. Numerically the mass multiplied by the specific heat.

"Heated Space" means a volume within a building which is provided with a positive supply of thermal energy by a system whose output capacity either exceeds 10 Btu/h·ft^2 or is capable of maintaining a space dry-bulb temperature of 50 °F or more at design building conditions.

"Heating System Performance Factor" means the total heating output of a heat pump during its normal annual usage period for heating, in Btu, divided by the total electric energy input during the same period, in watt-hours.

"Heat Trap" means a device coupled to the inlet and outlet of a water heater that effectively restricts the natural tendency of hot water to rise in the vertical pipe during periods of standby.

"Humidistat" means an automatic control device responsive to changes in humidity.

"Illuminance" means the density of the luminous flux incident on a surface. It is the quotient of the luminous flux multiplied by the area of the surface when the latter is uniformly illuminated. (See also *Footcandle.*)

"Industrial Process" means any manufacturing or other process whose energy requirements are not primarily intended to contribute to the heating, cooling, lighting, ventilation, or service hot water energy load requirements of the building.

"Infiltration" means the uncontrolled inward air leakage through cracks and crevices in any building element and around windows and doors of a building.

"Insolation" means the rate of solar energy incident on a unit area with a given orientation.

"Integrated Part-Load Value" means a single number figure of merit for air-conditioning and heat pump equipment based on weighted operation at a set of less than full capacities for the equipment.

"Lighting Power Budget" means the lighting power, in watts, allowed for an interior or exterior area or activity.

"Lighting Power Control Credit" means the amount of interior connected lighting power which may be added to the Interior Lighting Power Allowance for lights in a space which is turned off or dimmed by automatic control devices.

"Lumen" means SI unit of luminous flux. Radiometrically, it is determined from the radiant power. Photometrically, it is the luminous flux emitted within a unit solid angle (one steradian) by a point source having a uniform luminous intensity of one candela.

"Lumen Maintenance Control" means a device that senses the illumination level and causes an increase/decrease of illuminance to maintain a preset illumination level.

"Luminaire" means a complete lighting unit consisting of a lamp or lamps together with the parts designed to distribute the light, to position and protect the lamps, and to connect the lamps to the power supply.

"Luminaire Efficiency" means the ratio of luminous flux (lumens) emitted by a luminaire to that emitted by the lamp or lamps used therein.

"Manual (Non-Automatic)" means action requiring personal intervention for its control. As applied to an electric controller, non-automatic control does not necessarily imply a manual controller, but only that personal intervention is necessary. (See *Automatic*.)

"Marked Rating" means the design load operating conditions of a device as shown by the manufacturer on the nameplate or otherwise marked on the device.

"Minimum Life Cycle Cost Methodology" means the methodology specified in Subpart A of 10 CFR Part 436.

"Motor Efficiency, Nominal" means the median efficiency occurring in a population of motors of the same manufacturer and rating.

"Multi-Family High Rise Residential Building" means a residential building containing three or more dwelling units and is designed to be 3 or more stories above grade.

"Multi-Family Low Rise Residential Building" means a residential building containing three or more dwelling units and is designed not to exceed two stories above grade.

"Non-Depletable Energy Sources" means sources of energy, excluding minerals, derived from incoming solar radiation; thermal chemical or electrical energy derived directly from conversion of incident solar radiation; wind, waves and tides, lake, or pond thermal differences; and energy derived from the internal heat of the earth.

"Occupancy Sensor" means a device that detects the presence or absence of people within an area and causes lighting, equipment, and/or appliances to be adjusted accordingly.

"Opaque Areas" means all exposed areas of a building envelope which enclose conditioned space, except fenestration areas and building service openings, such as vents, grilles, and pipes.

"Orientation" means the directional placement of a building on a building site with reference to the building's longest horizontal axis, or, if none, with reference to the designated main entrance.

"Outdoor (Outside) Air" means air taken from the exterior of the building that has not been previously circulated through the building. (See also *Ventilating Air*.)

"Ozone Depletion Factor" means a relative measure of the potency of chemicals in depleting stratospheric ozone. The ozone depletion factor potential depends upon the chlorine and the bromine content and atmospheric lifetime of the chemical. The depletion factor potentials are normalized such that the factor for CFC-11 is set equal to unity and the factors for the other chemicals indicate their potential relative to CFC-11.

"Packaged Terminal Air-Conditioner" means a factory-selected wall sleeve and separate unencased combination of heating and cooling components, assemblies or sections, intended for mounting through the wall to serve a single room or zone. It includes heating capability by hot water, steam, or electricity.

"Packaged Terminal Heat Pump" means a PTAC capable of using the refrigeration system in a reverse cycle or heat pump mode to provide heat.

"Piping" means a system for conveying fluids, including pipes, valves, strainers, and fittings.

"Plenum" means an enclosure that is part of the air handling system and is distinguished by having a very low air velocity. A plenum often is formed in part or in total by portions of the building.

"Power" means, in connection with machines, the time rate of doing work; in connection with the transmission of energy of all types, the rate at which energy is transmitted; in inch-pound units, is measured in watts (W) or British thermal units per hour (Btu/h).

"Power Adjustment Factor" means a modifying factor that adjusts the effective connected lighting power of a space to account for the use of energy conserving lighting control devices.

"Power Factor" means the ratio of total watts to the root-mean-square (RMS) volt amperes.

"Prescribed Assumption" means a fixed value of an input to the standard calculation procedure.

"Process Energy" means energy consumed in support of a manufacturing, industrial, or commercial process, other than the maintenance of comfort and amenities for the occupants of a building.

"Process Load" means the calculated or measured time-integrated load on a building resulting from the consumption or release of process energy.

"Proposed Design" means a prospective design for a building that is to be evaluated for compliance.

"Prototype Building" means a generic building design of the same size and occupancy type as the proposed design, which complies with the prescriptive requirements of the standards and has prescribed assumptions used to generate the energy budget concerning shape, orientation, HVAC, and other system designs.

"Public Facility Restroom" means a restroom used by the transient public.

"Radiant Comfort Heating" means a system in which temperatures of room surfaces are adjusted to control the rate of heat loss by radiation from occupants.

"Readily Accessible" means capable of being reached quickly for operation, renewal, or inspections, without requiring those to whom ready access is requisite to climb over or remove obstacles or to resort to portable ladders, chairs, and so on. (See also *Accessible*.)

"Recooling" means lowering the temperature of air that has been previously heated by a heating system.

"Recovered Energy" means energy utilized which would otherwise be wasted (not contributing to a desired end use) from an energy utilization system.

"Reference Building" means a specific building design that has the same form, orientation and basic systems as the proposed design and meets all the criteria of the prescriptive compliance method.

"Reflectance" means the ratio of the light reflected by a surface to the light incident upon it.

"Reheating" means raising the temperature of air that has been previously cooled either by a refrigeration or an economizer system.

"Reset" means adjustment of the controller set point to a higher or lower value automatically or manually.

"Residential" means any structure which is constructed and developed for residential occupancy.

"Retail Establishments" means, for the purpose of determining lighting power limit, buildings, the primary functions of which are designed to be

(1) Type A—Jewelry Merchandising, where the minute display and examination of merchandise is critical.

(2) Type B—Fine Merchandising: Fine apparel and accessories, china, crystal and silver, art galleries, etc., where the detailed display and examination of merchandise is important.

(3) Type C—Mass Merchandising, where focused display and detailed examination of merchandise is important.

(4) Type D—General Merchandising: General apparel, variety, stationery, books, sporting goods, hobby, cameras, gift, luggage, etc., where general display and examination of merchandise are adequate.

(5) Type E—Food & Miscellaneous: Bakeries, hardware and housewares, grocery, appliances and furniture, etc., where appetizing appearance is important.

(6) Type F—Service Establishments, where functional performance is important.

"Roof" means those portions of the building envelope including all opaque surfaces, fenestration, doors, and hatches which are above conditioned space and which are horizontal or tilted at less than 45° from horizontal. (See also *Walls*.)

"Room Air Conditioner" means an encased assembly designed as a unit to be mounted in a window or through a wall, or as a console. It is designed primarily to provide free delivery of conditioned air to an enclosed space, room, or zone. It includes a prime source of refrigeration for cooling and dehumidification and means for circulating and cleaning air, and may also include means for ventilating and heating.

"Seasonal Energy Efficiency Ratio" means the total cooling output of an air conditioner during its normal annual usage period for cooling, in Btu/h, divided by the total electric energy input during the same period, in watt-hours, as determined by 10 CFR, Part 430.

"Service Systems" means all energy-using or distributing components in a building that are operated to support the occupant or process functions housed therein, including HVAC, service water heating, illumination, transportation, cooking or food preparation, laundering or similar functions.

"Service Water Heating" means the supply of hot water for purposes other than comfort heating and process requirements.

"Service Water Heating Demand" means the maximum design rate of water withdrawal from a service water heating system in a designated period of time (usually an hour or a day).

"Shading Coefficient" means the ratio of solar heat gain through fenestration, with or without integral shading devices, to that occurring through unshaded ⅛ inch thick clear, double strength glass.

"Shell Building" means a building for which the envelope is designed and/or constructed prior to knowing the occupancy type. (See also *Speculative Building*.)

"Speculative Building" means a building for which the envelope is designed and/or constructed prior to the design of the lighting and/or HVAC systems. A speculative building differs from a shell building in that the intended occupancy is known for the speculative building. (See also *Shell Building*.)

"Standard Calculation Procedure" means an energy simulation model, and a set of input assumptions, that produce estimates of annual energy consumption for heating, cooling, ventilation, lighting, and other uses and that account for the dynamic thermal performance of the building.

"System" means a combination of equipment and/or controls, accessories, interconnecting means, and terminal elements by which energy is transformed so as to perform a specific function, such as HVAC, service water heating, or illumination.

"Tandem Wiring" means pairs of luminaires operating with one lamp in each luminaire powered from a single two-lamp ballast contained in the other luminaire.

"Task Lighting" means lighting that provides illumination for specific visual functions and is directed to a specific surface or area.

"Task Location" means an area of the space where significant visual functions are performed and where lighting is required above and beyond that required for general ambient use.

"Terminal Element" means a device by which the transformed energy from a system is finally delivered; *i.e.*, registers, diffusers, lighting fixtures, faucets, etc.

"Thermal Conductance" means the constant time rate of heat flow through unit area of a body induced by a unit temperature difference between the surfaces, Btu/ft²·h·°F or Btu/h·°F. It is reciprocal of thermal resistance. (See *Thermal Resistance.*)

"Thermal Mass" means materials with mass heat capacity and surface area capable of affecting building loads by storing and releasing heat as the interior and/or exterior temperature and radiant conditions fluctuate. (See also *Wall Heat Capacity.*) Thermal Mass Wall Insulation Position:

(1) "Exterior Insulation Position" means a wall having all or nearly all of its mass exposed to the room air with the insulation on the exterior of that mass.

(2) "Integral Insulation Position" means a wall having mass exposed to both room and outside air, with substantially equal amounts of mass on the inside and outside of the insulation layer.

(3) "Interior Insulation Position" means a wall not meeting either of the above definitions, particularly a wall having most of its mass external to an insulation layer.

"Thermal Resistance" means the reciprocal thermal conductance; 1/C as well as 1/h, 1/U, h·ft²·°F/Btu.

"Thermal Transmittance" means the overall coefficient of heat transfer from air to air. It is the time rate of heat flow per unit area under steady conditions from the fluid on the warm side of the barrier to the fluid on the cold side, per unit temperature difference between the two fluids, Btu/h·ft²·°F.

"Thermal Transmittance, Overall" means the gross overall (area weighted average) coefficient of heat transfer from air to air for a gross area of the building envelope, Btu/h·ft²·°F. The thermal transmittance (U°) value applies to the combined effect of the time rate of heat flows through the various parallel paths, such as windows, doors, and opaque construction areas, comprising the gross area of one or more building envelope components, such as walls, floors, or roof/ceiling.

"Thermostat" means an automatic control device responsive to temperature.

"Unconditioned Space" means a volume within a building that is not designed to be directly or indirectly heated and/or cooled. (See *Conditioned Space.*)

"Unit Power Density" means the floor area designated for a specific occupancy, function, or activity expressed in W/ft².

"Unitary Cooling Equipment" means one or more factory-made assemblies which normally include an evaporator or cooling coil, a compressor and condenser combination, and may include a heating function as well.

"Unitary Heat Pump" means one or more factory-made assemblies which normally include an indoor conditioning coil, compressor(s) and outdoor coil or refrigerant-to-water heat exchanger, including means to provide both heating and cooling functions.

"Unlisted Space" means the difference in area between the gross lighted area and the sum of all listed spaces.

"Variable Air Volume (VAV) HVAC System" means HVAC systems that control the dry-bulb temperature within a space by varying the volume of supply air to the space.

"Ventilation" means the process of supplying or removing air by natural or mechanical means to or from any space. Such air may or may not have been conditioned.

"Ventilation Air" means that portion of supply air which comes from outside (outdoors) plus any recirculated air that has been treated to maintain the desired quality of air within a designated space. (See also *Outdoor Air.*)

"Visual Task" means those details and objects that must be seen for the performance of a given activity, and includes the immediate background of the details or objects.

"Voluntary Performance Standards" means an energy consumption goal or goals to be met without specification of the method, materials, and process es to be employed in achieving that goal or goals, but including statements of the requirements, criteria and evaluation methods to be used, and any necessary commentary.

"Walls" means those portions of the building envelope enclosing conditioned space including all opaque surfaces, fenestration and doors, which are vertical or tilted at an angle of 45° from horizontal or greater. (See also *Roof*.)

"Wall Heat Capacity" means the sum of the products of the mass of each individual material in the wall per unit area of wall surface times its individual specific heat, Btu/F. (See *Thermal Mass*.)

"Watt" means a unit of power. One watt is produced when one ampere, flows at an amp of one volt (unity power factor). (See also *Power*.)

"Zone" means a space or group of spaces within a building with heating, cooling, and/or lighting requirements sufficiently similar so that desired conditions can be maintained throughout by a single controlling device.

(b) For definitions not found in paragraph (a) of this section, the 1986 edition of "Terminology of Heating and Ventilation, Air-Conditioning, and Refrigeration" as published by the American Society of Heating, Refrigeration, and Air-Conditioning Engineers, Inc. (ASHRAE) shall apply to these standards.

(c) For purposes of this subpart, the acronyms and abbreviations shall have the following meanings:

A_o—Total Building Floor Area.
$A_{wall, roof, etc.}$—Area of a Specific Building component.
AAMA—American Aluminum Manufacturers Association.
ACP—Alternative Component Package.
AF—Area Factor.
AFUE—Annual Fuel Utilization Efficiency.
AHAM—Association of Home Appliance Manufacturers.
ALP—Adjusted Lighting Power.
ANSI—American National Standards Institute.
ARI—Air-Conditioning and Refrigeration Institute.
ASHRAE—American Society of Heating, Refrigeration and Air Conditioning Engineers, Inc.
ASME—American Society of Mechanical Engineers.
ASTM—American Society for Testing and Materials.
Btu—British Thermal Unit.
Btu/h—British Thermal Units Per Hour.
C—Thermal Conductance.
C_c—Cooling Criteria.
CDD—Cooling Degree-Days.
CDD50—Cooling Degree-Days Base 50 °F.
CDD65—Cooling Degree-Days Base 65 °F.
CDH—Cooling Degree-Hours.
CDH80—Cooling Degree-Hours Base 80 °F.
CEEU—Cost Equivalent Energy Units.
cfm—Cubic Feet Per Minute.
CFR—Code of Federal Regulations.
CLP—Connected Lighting Power.
COP—Coefficient of Performance.
CU—Coefficient of Utilization.
DOE—U.S. Department of Energy.
DR—Average Daily Temperature Range for Warmest Month.
EER—Energy Efficiency Ratio.
ELPA—Exterior Lighting Power Allowance.
EPD—Equipment Power Density.
°F—Degrees-Fahrenheit
GLA—Gross Lighted Building Area.
HC—Heat Capacity.
HDD—Heating Degree-Days.
HDD50—Heating Degree-Days Base 50 °F.
HDD65—Heating Degree-Days Base 65 °F.
HI—Hydronics Institute.
HID—High Intensity Discharge.
hp—Horsepower (force).
HPS—High Pressure Sodium.
HSPF—Heating System Performance Factor.
HVAC—Heating, Ventilating and Air Conditioning.
IEEE—Institute of Electrical and Electronics Engineers, Inc.
IES—Illuminating Engineering Society of North America.
ILPA—Interior Lighting Power Allowance.
IPLV—Integrated Part Load Value.
ILD—Internal Load Density.
IRF—Internal Reflecting Film.

ISSC—Internal Shading System Coefficient.
K_a—Daylighting Factor.
kVA—Kilo-Volts Amperes.
kW—Kilo-Watts.
LPB—Lighting Power Budget.
LPCC—Lighting Power Control Credits.
LS—Listed Space.
NWMA—National Woodwork Manufacturers Association.
o.c.—On Center.
OLA—Occupant Load Adjustment.
OMB—U.S. Office of Management and Budget.
P_b—Base Unit Lighting Power Allowance.
PAF—Power Adjustment Factor.
PF—Projection Factor.
PTAC—Packaged Terminal Air-Conditioner.
R—Thermal Resistance.
r—Thermal Resistivity.
S_m—Shading Horizontal Adjustment Factor.
SC—Shading Coefficient.
SEER—Seasonal Energy Efficiency Ratio.
U_o—Average Thermal Transmittance.
UL—Underwriter's Laboratories, Inc.
ULPA—Unit Lighting Power Allowance.
UPD—Unit Power Density.
VAV—Variable Air Volume.
VCP—Visual Comfort Probability.
VDT—Visual Display Terminal.
VLT—Visible Light Transmittance.
VSEW—Vertical Surface of the Facade.
W.C.—Water Column.
W—Watts.
W/ft^2—Watts Per Square Foot.
W/lin.ft—Watts Per Linear Foot.
W_h—Window Height.
WWR—Window Wall Ratio.
WYEC—Weather Year for Energy Conservation Calculations.

§ 435.100 Explanation of numbering system for standards.

(a) For purposes of this subpart, a derivative of two different numbering systems will be used.

(1) For the purpose of designating a section, the system employed in the Code of Federal Regulations (CFR) will be employed. The number "435," which signifies Part 435, Chapter II of Title 10, Code of Federal Regulations, is used as a prefix for all section headings. The suffix is a two or three digit number beginning with ".97." For example, the lighting section of the standards is numbered § 435.103.

(2) Within each section, a numbering system common to many national voluntary consensus standards is used. This system was chosen because of its commonality among the buildings industry. A decimal system is used to denote sections and subsections. For example, § 9.4.2 refers to section 9, subsection 4, paragraph 2.

(b) The hybrid numbering system is used for two purposes:

(1) The use of the Code of Federal Regulation's numbering system allows the researcher using the CFR easy access to the standards.

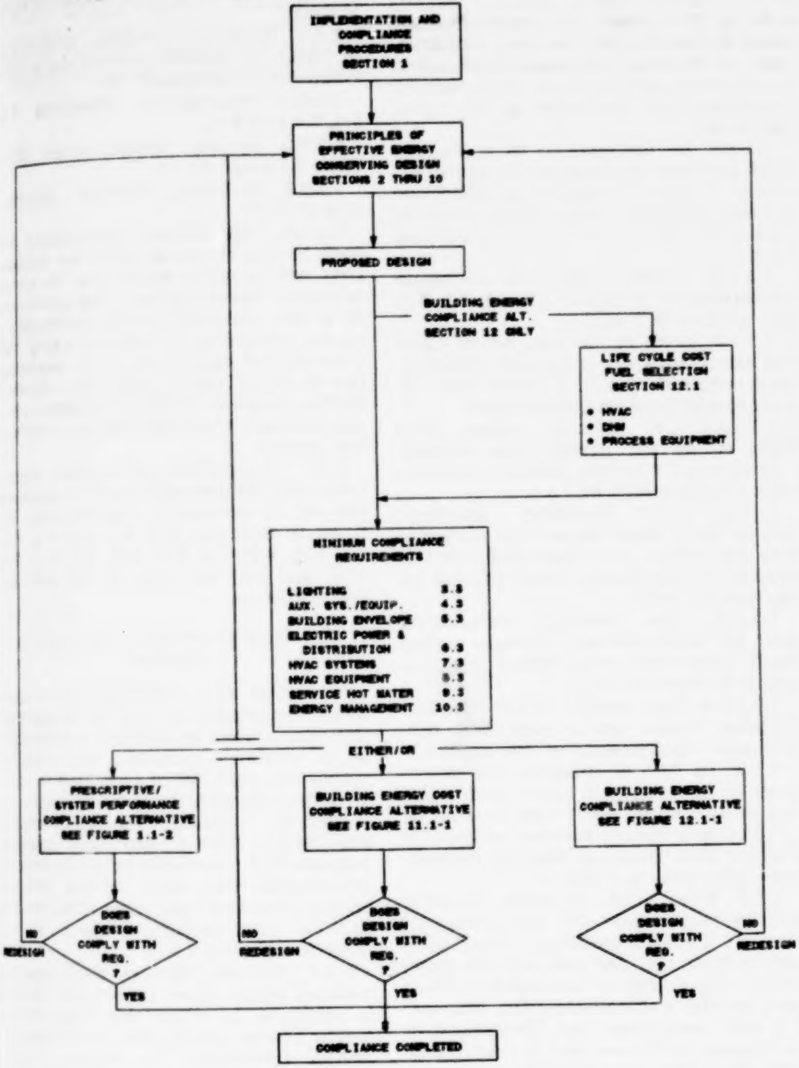
(2) The use of the second system allows the builder, designer, architect or engineer easy access because they are used to the system employed.

(c) To avoid confusion in the use of the two systems, § 435.101 through § 435.112, the substantive technical sections of the standards, have been numbered so that the last two digits in the suffix designate the section. For example, once the reader enters the body of § 435.105: Building Envelope, the number "5" is used to designate the section. References throughout the standard do not employ the "435" prefix but rather refer to the section by the single or double digit numbers from 1-12.

§ 435.101 Implementation and compliance procedures for Federal agencies.

Alternative methods of achieving compliance are illustrated in Figure 1.1-1.

Figure 1.1-1 Alternative Methods of Achieving Compliance


IMPLEMENTATION AND COMPLIANCE PROCEDURES SECTION 1
PRINCIPLES OF EFFECTIVE ENERGY CONSERVING DESIGN SECTIONS 2 THRU 10
PROPOSED DESIGN
BUILDING ENERGY COMPLIANCE ALT. SECTION 12 ONLY
LIFE CYCLE COST FUEL SELECTION SECTION 12.1
• HVAC
• DHW
• PROCESS EQUIPMENT
MINIMUM COMPLIANCE REQUIREMENTS
LIGHTING 3.3
AUX. SYS./EQUIP. 4.3
BUILDING ENVELOPE 5.3
ELECTRIC POWER & DISTRIBUTION 6.3
HVAC SYSTEMS 7.3
HVAC EQUIPMENT 8.3
SERVICE HOT WATER 9.3
ENERGY MANAGEMENT 10.3
EITHER/OR
PRESCRIPTIVE/ SYSTEM PERFORMANCE COMPLIANCE ALTERNATIVE SEE FIGURE 1.1-2
BUILDING ENERGY COST COMPLIANCE ALTERNATIVE SEE FIGURE 11.1-1
BUILDING ENERGY COMPLIANCE ALTERNATIVE SEE FIGURE 12.1-1
DOES DESIGN COMPLY WITH REG. ?
NO
REDESIGN
YES
DOES DESIGN COMPLY WITH REG. ?
NO
REDESIGN
YES
DOES DESIGN COMPLY WITH REG. ?
NO
REDESIGN
YES
COMPLIANCE COMPLETED

1.1 Compliance

1.1.1 The head of each Federal agency responsible for the construction of Federal buildings shall adopt such procedures as may be necessary to assure that the design of the building shall:

1.1.1.1 be undertaken in a manner that provides for appropriate consideration of the Principles of Effective Energy Building Design prescribed in §§ 2.0, 3.2, 4.2, 5.2, 6.2, 7.2, 8.2, 9.2 and 10.2;

1.1.1.2 comply with the minimum requirements of §§ 3.3, 4.3, 5.3, 6.3, 7.3, 8.3, 9.3 and 10.3; and

1.1.1.3 meet or exceed, based upon the analysis of life-cycle cost-effectiveness required by § 1.1.2 below, the following additional requirements:

1.1.1.3.1 the lighting design shall meet either the prescriptive requirements of § 3.4 or the system performance requirements of § 3.5,

1.1.1.3.2 the building envelope design shall meet either the prescriptive requirements of Section 5.4 or the system performance requirements of Section 5.5, and

1.1.1.3.3 the heating, ventilating and air conditioning systems design shall meet the prescriptive requirements of Section 7.4, and

1.1.1.3.4 the service water heating systems design shall meet the prescriptive requirements of Section 9.4.

1.1.2 In lieu of meeting the provisions of Section 1.1.1 above, the building design shall meet the criteria of the building energy method of Section 11.0 or 12.0, Building Energy Compliance Alternatives I and II.

1.1.3 The head of each Federal agency responsible for the construction of Federal buildings shall also assure that the decision-making process for the design of the building shall employ the methodology for estimating and comparing the life-cycle cost of Federal buildings and for determining life-cycle cost-effectiveness prescribed in Subpart A of 10 C.F.R. Part 436.

1.2 General Approach to Compliance

1.2.1 The standards, in addition to minimum requirements, establish three alternate methods to determine whether the design has achieved compliance.

1.2.2 There are several alternative methods of achieving compliance provided for in the standards:

1.2.2.1 Prescriptive (Sections 3.4, 5.4, 7.4 and 9.4),

1.2.2.2 System Performance (Sections 3.5 and 5.5), or

1.2.2.3 Building Energy (Sections 11.0 or 12.0).

1.2.2.4 The criteria established for each of the methods allow for designs that are roughly equivalent in terms of energy conservation. The equivalency of the methods can be demonstrated by designing a building using the Prescriptive approach, then modeling the building using either the System Performance or Building Energy criteria calculation procedures and comparing results.

1.2.3 Compliance with these standards shall be demonstrated by meeting the set of minimum requirements defined in Sections 3.2, 3.3, 4.2, 4.3, 5.2, 5.3, 6.2, 6.3, 7.2, 7.3, 8.2, 8.3, 9.2, 9.3, 10.2, and 10.3 and one of the alternative methods.

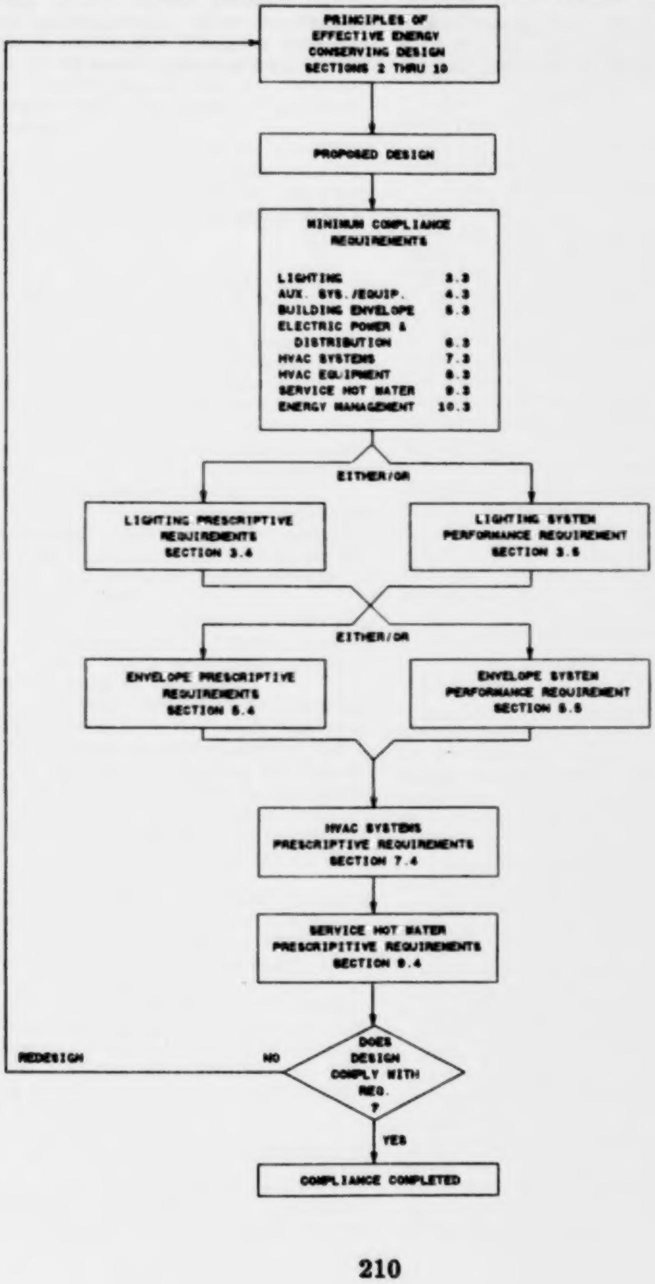
1.3 How To Select a Compliance Method

1.3.1 Use the Prescriptive method when the minimum amount of calculation and effort to achieve compliance is of primary concern. Its requirements can be readily specified in construction documents and are easily reviewed by building code enforcement authorities. The Prescriptive method permits few trade-offs or optimization procedures, but does permit several energy-effective and cost-effective alternate construction options to be used. See Figure 1.1-2.

1.3.2 Use the System Performance method when more innovative design is required, or when the Prescriptive method does not provide the necessary design flexibility. It requires more manual calculations than the Prescriptive method. See Figure 1.1-2

1.3.3 Use either of the Building Energy methods (Sections 11.0 or 12.0) when the most innovative design concepts are being considered. The Building Energy methods allow the trade-off of energy among the building systems as long as the total calculated design annual energy consumption does not exceed the limit prescribed. It will, in general, require the use of a computer program to simulate the operation of the various systems and to model building design energy use in accordance with the building loads and the proposed schedules of operation. See Figures 11-1 and 12-1.

Figure 1.1-2 Prescriptive/System Performance Compliance Alternatives


PRINCIPLES OF EFFECTIVE ENERGY CONSERVING DESIGN SECTIONS 2 THRU 10
PROPOSED DESIGN
MINIMUM COMPLIANCE REQUIREMENTS
LIGHTING 3.3
AUX. SYS./EQUIP. 4.3
BUILDING ENVELOPE 5.3
ELECTRIC POWER & DISTRIBUTION 6.3
HVAC SYSTEMS 7.3
HVAC EQUIPMENT 8.3
SERVICE HOT WATER 9.3
ENERGY MANAGEMENT 10.3
EITHER/OR
LIGHTING PRESCRIPTIVE REQUIREMENTS SECTION 3.4
LIGHTING SYSTEM PERFORMANCE REQUIREMENT SECTION 3.5
EITHER/OR
ENVELOPE PRESCRIPTIVE REQUIREMENTS SECTION 5.4
ENVELOPE SYSTEM PERFORMANCE REQUIREMENT SECTION 5.5
HVAC SYSTEMS PRESCRIPTIVE REQUIREMENTS SECTION 7.4
SERVICE HOT WATER PRESCRIPITIVE REQUIREMENTS SECTION 9.4
DOES DESIGN COMPLY WITH REQ. ?
REDESIGN
NO
YES
COMPLIANCE COMPLETED

§435.102 Principles of effective energy building design.

2.1 *General*

2.1.1 This section complements the other sections of the standards by providing general principles of effective building design. The intention of this section is to provide ideas on how to improve the integration of the building's major energy using subsystems in a cost-effective manner without compromising the building's intended functional use or internal environmental conditions. In addition, more narrowly focused principles are included in sections 3.0 through 10.0.

2.1.2 To comply with the principles of effective design, designers shall use their professional judgment to identify the building's most significant energy requirements and select appropriate solutions from the general strategies found in this section and the more specific strategies found in sections 3.0 through 10.0.

2.2 *Identification of Significant Energy Requirements*

2.2.1 Before energy design strategies can be developed for a commercial or multi-family high rise residential building, a clear picture of its most significant energy requirements must be developed. The basic approach to achieving an energy conscious design is to improve the energy efficiency of the building by shifting or reducing loads, improving transport systems, and providing efficient environmental systems and controls. This is accomplished by first determining which aspects of the building's energy requirements are the most significant, those that would result in the largest annual energy costs to the building owner if energy conserving strategies were otherwise not applied. For example, for a given building, the largest annual energy cost component may be lighting, followed by cooling, heating, and ventilation, respectively. In this example electricity would be the major energy source. Therefore, peak timerates of energy use (i.e., peak power demands), as well as direct energy use, would have to be included in any energy analysis. Consideration of peak demands will reduce the requirement for oversizing of energy systems in the building and will also have the added impact of helping to reduce the need for additional, low utilization peak capacity on utility grids.

2.2.2 Once the most significant cost components of the building's energy requirements have been determined, apply the strategies and design solutions listed below and those that appear in each of the following sections of the standards. In the example noted above, lighting solutions would be addressed first, followed by cooling, heating, and then ventilation.

2.2.3 Research results indicate that the most significant energy uses for any given commercial or multi-family high rise residential building are generally not accurately identifiable by professional intuition. Therefore, use shall be made of one of the several available analysis tools, some of which are microcomputer-based.

2.3 *General Solution Strategies*

2.3.1 Consider energy efficiency from the initiation of the building design process, since design improvements are most easily and effectively made at that time. Seek the active participation of members of the design team early in the design process, including the owner, architect, engineer, and builder, if possible. Consider building attributes such as building function, form, orientation, window/wall ratio, and HVAC system types early in the design process. Each has major energy implications. These considerations most likely will result in solutions that minimize both construction and operation costs, including energy demand charges.

2.3.2 Address the building's energy requirements in the following sequence: minimize impact of the building functional requirements; minimize loads; improve the efficiency of distribution and conversion systems; and integrate building subsystems into an efficient whole. Each of these is discussed below.

2.3.2.1 Minimize impact of functional requirements by identifying major areas that offer energy efficiency opportunities based on the building's functional use, human occupancy requirements, and site characteristics. These areas will vary considerably from building to building depending upon function and service requirements, and shall be considered when applying the criteria of these standards.

2.3.2.2 Minimize loads by analyzing the external and internal loads to be imposed on building energy-using subsystems, both for peak-load and part-load conditions. Include a determination of how the building relates to its external environment in the analysis, either adaptively or defensively. Consider changes in building form, aspect ratio, and other attributes that reduce, redistribute, or delay (shift) loads.

2.3.2.3 Improve subsystems by analyzing the diversified energy and demand (power) requirements of each energy-using subsystem serving the functional requirements of the building. Consider static and dynamic efficiency of energy conversion and energy transport subsystems and include consideration of opportunities to reclaim, redistribute and store energy for later use.

2.3.2.4 Alternative ways to integrate systems into the building will be accomplished by considering both power and time components of energy use. Identify, evaluate, and design each of these components to control the overall design energy consumption. The following shall be considered when integrating major building subsystems:

2.3.2.4.1 Address more than one problem when developing design solutions, and make maximum use of building components already present for non-energy reasons (e.g., windows, structural mass);

2.3.2.4.2 Examine design solutions that consider time since sufficient energy may already be present from the environment (e.g., solar heat, night cooling) or from internal equipment (e.g., lights, computers) but available at different times than needed. Thus, active (heat pumps with water tanks) and passive (building mass) storage techniques may be considered;

2.3.2.4.3 Examine design solutions that consider anticipated space utilization. For example, in large but relatively unoccupied spaces, task or zone heating may be considered. Transporting energy (light and heat) from locations of production and availability to locations of need shall be considered instead of the purchase of additional energy;

2.3.2.4.4 Never reject waste energy at temperatures usable for space conditioning or other practical purposes without calculating the economic benefit of energy recovery;

2.3.2.4.5 Consider design solutions that provide more comfortable surface temperatures or increase availability of controlled daylight in buildings in which human occupancy is a primary function;

2.3.2.4.6 Use design solutions that are easily understood as they have a greater probability of use by building occupants; and

2.3.2.4.7 Where the functional requirements of the building may change, the installed environmental system should be designed to be adaptable to meet functional changes that can be anticipated as well as providing flexibility to meet indeterminate future changes in use, occupancy or other functions.

§ 435.103 Lighting.

3.1 General

3.1.1 This section contains principles of design, a set of minimum requirements, and two alternative compliance procedures, prescriptive and systems performance, for the design of building lighting and lighting control systems, and includes provisions for daylighting credit. The procedures in this section are solely for use in establishing lighting design budgets and are not intended for use as lighting design procedures.

3.1.2 *Scope.* The following are covered by this section:

3.1.2.1 Interior spaces of buildings;

3.1.2.2 Building exteriors and exterior areas, such as entrances, exits and loading docks; and

3.1.2.3 Roads, grounds, parking and other exterior areas where lighting is energized through the building electrical service.

3.1.3 *Exemptions*. The following are exempt from these standards:

3.1.3.1 Outdoor manufacturing, commercial greenhouses, and processing facilities;

3.1.3.2 Lighting power for theatrical production studios and stages, television broadcasting studios, audio-visual presentation, and entertainment facilities in spaces such as stages, hotel ballrooms, nightclubs, discos, and casinos, and where lighting is an essential technical element for the function performed;

3.1.3.3 Specialized luminaires for medical and dental purposes;

3.1.3.4 Outdoor athletic facilities;

3.1.3.5 Lighting power for display lighting required for art exhibits or displays in galleries, museums and monuments;

3.1.3.6 Exterior lighting for public monuments;

3.1.3.7 Special lighting needs for research;

3.1.3.8 Lighting power for lighting used solely for indoor plant growth during the hours of 10:00 p.m. to 6:00 a.m.;

3.1.3.9 Emergency lighting that is automatically "off" during normal operation;

3.1.3.10 High risk security areas or any area identified by local ordinances or regulations or by security or safety personnel as requiring additional lighting;

3.1.3.11 Lighting power densities for spaces with enhanced lighting specifically designed for primary use by the visually impaired, hard of hearing, or for senior citizens;

3.1.3.12 Lighting for signs;

3.1.3.13 Store-front exterior-enclosed display windows in retail facilities; and

3.1.3.14 Lighting for dwelling units.

3.1.4 *Building Lighting Power Allowance*. The lighting power allowance for a building consists of the Exterior Lighting Power Allowance (ELPA), in accordance with Section 3.3, plus the Interior Lighting Power Allowance (ILPA) in accordance with Section 3.4 or 3.5. This lighting power allowance is the upper limit to which the building can be designed, based on the criteria of the compliance alternative chosen.

3.1.4.1 The prescriptive criteria in Section 3.4 provides a single compliance procedure based on calculating a lighting budget by building type or major area type within which a designer can flexibly design a lighting solution. To obtain credit for specific lighting energy conservation measures, use Section 3.5, Section 11.0, or Section 12.0.

3.1.4.2 The systems performance criteria in Section 3.5 provides a more complex compliance procedure based on calculating a lighting budget by activity or spaces within which the designer can flexibly design a lighting solution and receive credit for energy conserving controls and daylighting measures. To receive credit for more complex lighting conservation measures use Section 11.0 or 12.0.

3.1.5 *Credit for Daylighting*. Daylighting credit, for reduced use of electric lighting energy resulting from the use of automatic lighting control devices in conjunction with fenestration (e.g., windows and skylights), may be taken if the systems performance alternative in Section 3.5 is chosen. However, if such daylighting credit is to be applied to other building subsystems, such as use of additional fenestration area, Section 11.0 or 12.0 must be used. Thermal credit provisions for daylighting are found in Section 5.0.

3.1.6 *Compliance*. A building shall be considered in compliance with this Section if the following conditions are met:

3.1.6.1 The minimum requirements of Section 3.3 are met;

3.1.6.2 The exterior lighting power to be installed is not greater than the Exterior Lighting Power Allowance (ELPA), calculated using Equation 3.3-1;

3.1.6.3 The interior lighting power to be installed is not greater than the Interior Lighting Power Allowance (ILPA), based on either the Prescriptive Criteria in Section 3.4 or the Systems Performance Criteria in Section 3.5.

3.1.6.4 Tradeoffs between ILPA and ELPA are not allowed. Tradeoffs of the interior Lighting Power Budgets (LPB) among interior spaces are allowed as long as the total Connected Lighting Power (CLP) within the building does not exceed the Interior Lighting Power Allowance (ILPA) and Lighting Power Control Credits (LPCC) are used only for connected lighting power in those spaces for which credit is claimed. Tradeoffs of exterior lighting power budgets among exterior areas are allowed as long as the total Connected Lighting Power (CLP) of exterior lighting does not exceed the Exterior Lighting Power Allowance (ELPA) and the allowance for the building exterior surfaces is not exceeded.

3.1.7 *Multi-Building Facilities.* The total lighting power allowances for each building in a multi-building facility shall be calculated separately.

3.2 Principles of Design

3.2.1 The lighting system is designed to provide a productive, safe, and pleasing visual environment for the intended use of the space. However, lighting is both a major energy end use in commercial buildings (especially in office buildings) and a major contributor to internal loads by increasing cooling loads and decreasing heating loads. Therefore, it is important to produce a design that meets the lighting functional criteria of the space as well as one that minimizes energy use. Recommended maintained illuminance levels for visual tasks and surrounding lighted areas are included in the *IES Lighting Handbook, Applications (1983) or Reference (1985)*. Principles of energy conserving design within that context are described below.

3.2.2 The following Design Concepts shall be considered in the design of lighting that is both energy efficient and visually effective.

3.2.2.1 Energy use is determined by the lighting load (demand power) and its duration of use (time). Minimize the actual demand load rather than just the apparent connected load, and control the load rather than just switching, if switching may adversely affect the quality of the luminous environment.

3.2.2.2 Consider daylighting along with the proper use of controls so that the savings from electric lighting can be realized. Design should be sensitive to window glare, sudden changes in luminances, and general use acceptance of controls. Window treatment (blinds, drapes and shades) and glazing should be carefully selected to control direct solar penetration and luminance extremes while still maintaining view and daylight penetration.

3.2.2.3 Design lighting systems so that illumination required for tasks is primarily limited to the location of the task and from a direction that will minimize direct glare and veiling reflections on the task. For example, the ideal positioning of work stations is between the rows of ceiling-mounted luminaires with the direction of view parallel to the primary task. In densely-occupied work spaces, uniform distribution of general lighting may be most appropriate. Where supplementary task illumination is necessary, general or ambient illumination should not be lower than a third of the luminance required for the task. This will help maintain luminance rates that are visually comfortable.

3.2.2.4 Use task lighting, whenever possible, to accommodate the need for higher lighting levels due to task visual difficulty, glare, intermittently changing requirements, or individual visual differences (poor and aging eyesight).

3.2.2.5 Group similar activities so high illuminance or special lighting for particular tasks are localized in certain rooms or areas, and so that less efficient fixtures required for critical glare control do not have to be installed uniformly when they are only required sparsely.

3.2.2.6 When indirect lighting is appropriate, use schemes that create reasonably uniform ceiling luminances. If this is achieved, work spaces may be located anywhere and occupants may face in any direction without being subject to excessive veiling reflection on the tasks. The indirect system may allow more effective use of the space than other types of lighting systems. However, indirect lighting systems generally have lower utilization factors, and may require increased ceiling height to provide uniform ceiling luminance.

3.2.2.7 Use lighting controls throughout that maintain proper lighting levels when and where it is needed but also allow reductions in lighting when tasks are less critical, or spaces are not fully occupied. The designer must consider user acceptance of control strategies to maximize energy efficiency.

3.2.2.8 Use lower levels of ambient lighting in situations such as merchandising, where the contrast between accent lighting and ambient lighting is critical. Accent lighting shall not exceed five (5) times the ambient level. Consider fewer, more effectively-accented displays, rather than more ineffectively-accented ones.

3.2.3 The following guidelines identify Fixture and Lamp selection strategies to be considered in the selection of luminaires and lamps for inclusion in an energy efficient, visually-effective design:

3.2.3.1 Consider the use of more efficient equipment with appropriate distribution, glare control and visual characteristics. Utilize fixture designs that will provide high lighting efficiency while meeting the other lighting objectives of the installation.

3.2.3.2 Review visual comfort probability (VCP) data, available from manufacturers, for specific luminaires when minimizing discomfort glare is a criterion.

3.2.3.3 Consider luminaire construction that minimizes light loss due to dirt collection.

3.2.3.4 Investigate the use of dimmers to reduce energy consumption when the system is new and capable of providing more light than the average depreciated design value.

3.2.3.5 Use more efficient lamps with appropriate luminous efficacy, life expectancy and spectrum distribution and color rendering characteristics.

3.2.3.6 Use more efficient ballasts for fluorescent and HID lamps with appropriate ballast factors, power factor, noise rating, starting and restarting characteristics.

3.2.3.7 Use luminaires with heat removal and heat recovery capabilities, thereby allowing the lighting equipment to operate more efficiently at a lower ambient temperature.

3.2.3.8 Limit the use of lower efficiency lamps, such as incandescent, to only those applications where their color, lumens or distribution characteristics cannot be duplicated by other sources. Due to their lower efficiency, the use of "extended service" incandescent lamps should be limited to those applications where fixtures are difficult to reach and/or maintenance costs for revamping will be excessive.

3.2.4 Space Design

3.2.4.1 It is important to carry through on the lighting design when completing the interior design. Reduce light absorption by encouraging the use of lighter finishes, particularly on ceilings, walls and partitions. Select colors and surface materials so that their reflectance values are within the ranges recommended by the IES. This will aid the efficient use of light and help to provide comfortable luminance ratios.

3.2.4.2 In offices with visual display terminals (VDT) that are susceptible to reflections, it may be necessary to use reflectances for some room surfaces at the low end of the recommended ranges to reduce unwanted reflections on the screens. Where practical, treat the screens of VDTs with anti-glare materials to avoid veiling reflection.

3.3 Minimum Requirements

3.3.1 Lighting Controls.

3.3.1.1 All lighting shall be provided with manual, automatic, or programmable controls.

3.3.1.1.1 *Exception to Section 3.3.1.1:*

(a) controls for emergency or exit lighting.

3.3.1.2 *Minimum Number of Lighting Controls.* Each space enclosed by walls or ceiling-height partitions shall be provided with control(s) that, together or alone are capable of controlling all lights within that space, excluding those requiring continuous operation for security purposes.

3.3.1.2.1 The minimum number of controls shall not be less than:

(a) One lighting control for each space; and

(b) One lighting control for each task or group of task locations within an area of 450 ft^2 or less.

3.3.1.2.2 *Equivalent Number of Controls.* The minimum number of controls may be reduced, by using an equivalent number of controls from Table 3.3-1, where control types listed in Table 3.3-1 are used. However, the minimum number of controls may not be reduced to less than one control for each 1500 W of connected lighting power.

Table 3.3-1
Equivalent Number of Controls

TYPE OF CONTROL	EQUIVALENT NUMBER OF CONTROLS
Manually operated on-off switch	1
Occupancy sensor	2
Timer-Programmable from the space being controlled	2
Three level, including off, step control or pre-set dimming	2
Four level, including off, step control or pre-set dimming	3
Automatic or continuous dimming	3

3.3.1.2.3 *Exceptions to Section 3.3.1.2:*

(a) Lighting control requirements for spaces that must be used as a whole, such as public lobbies of office buildings, hotels, and hospitals; retail and department stores and warehouses, storerooms, and service corridors under centralized supervision, shall be controlled by a lesser number of controls, but not less than one control for each 1500 W of connected lighting power, or a total of three (3) controls, whichever is greater. Lighting in such spaces shall be controlled in accordance with the work activities.

(b) Hotel and motel guest rooms shall have one or more master controls at the main entry door that turn off all permanently wired lighting fixtures and lighting and television receptacles. For multiple room suites, controls at the entry of each room, in lieu of a master switch, will meet these requirements.

3.3.1.3 Controls provided for task areas, if readily accessible, may be mounted as part of the task lighting luminaire.

3.3.1.4 Control of the same load from more than one location shall not be credited as additional control points.

3.3.1.5 All lighting controls shall be readily accessible to personnel occupying or using the space. Exceptions are automatic controls, programmable controls, lighting for safety hazards and security, controls requiring trained operators, and those controls for spaces that must be used as a whole.

3.3.1.6 Exterior lighting shall be automatically controlled by timer, photocell, or combination of timer and photocell. Timers shall be of the automatic type or otherwise capable of adjustment for seven days and for seasonal daylight schedule variations. All time-controllers shall be equipped with back-up mechanisms to keep time during a four hour power outage.

3.3.1.7 When the building is served by an energy management system, programmable controls, shared tenant services that affect interior environments, or "intelligent building" systems, provisions shall be made to incorporate lighting controls into the system if a separate automatically-controlled lighting system is not provided.

3.3.2 Fluorescent Lamp Ballasts.

3.3.2.1 Fluorescent lamp ballasts shall have a ballast efficacy factor not less than that shown in Table 3.3-2.

3.3.2.1.1 *Exception to 3.3.2.1*: Ballasts not included in Table 3.3-2 and ballasts designed for use with dimming controls are excluded from these criteria.

Table 3.3-2

Fluorescent Ballast For Efficacy Factors*

NUMBER OF LAMPS	LAMP TYPE	NOMINAL OPERATIONAL INPUT VOLTAGE	DESIGN STARTING TEMPERATURE	INPUT FREQUENCY	MAX. LAMP OPERATING TEMPERATURE	MIN. BALLAST EFFICIENCY FACTOR
1	4 ft rapid start	120 or 277	>40 °F	60Hz	<1000 m amp	1.805
2	4 ft rapid start	120	>40 oF	60Hz	<1000 m amp	1.060
2	4 ft rapid start	277	>40 °F	60Hz	<1000 m amp	1.050
2	8 ft slimline	120 - 277	>40 °F	60Hz	<1000 m amp	0.570
2	8 ft high output, rapid start	120 - 277	<40 °F	60Hz	<1000 m amp	0.390

* For ballasts not specifically designed for use with dimming controls.

3.3.2.2 The Ballast Efficacy Factor shall be calculated in accordance with Equation 3.3-1:

$$BEF = \frac{BF}{\text{Power Input}}$$

Equation 3.3-1

Where:

BEF=Ballast Efficacy Factor.

BF=Ballast Factor, expressed as a percent.

Power Input=Total Wattage of combined lamps and ballasts

3.3.2.2.1 Tests for ballast factor and power input shall be in accordance with *ANSI Standard C-82.2-1984* "Method of Measurement for Fluorescent Lamp Ballasts", using "Standard" F40T1240A, F96T12 75 watt, or F96T12H0 110 watt lamps.

3.3.2.3 One-lamp or three-lamp fluorescent luminaires shall be tandem-wired to eliminate unnecessary use of single lamp ballasts if they are: used for general lighting; recess mounted within ten feet center-to-center of each other; or pendant or surface mounted within 1 ft of each other, and within the same room. Tandem wiring consists of pairs of luminaires operating with one lamp in a luminaire powered from a single two-lamp ballast contained in a second luminaire.

3.3.2.3.1 *Exception to Section 3.3.2.3*:

(a) Three-lamp ballasts may be used.

3.3.2.4 Fluorescent lamp ballasts shall have a power factor equal to or greater than 80%.

3.3.2.4.1 *Exception to 3.3.2.4*: Ballasts for circline and compact fluorescent lamps and low wattage, high intensity discharge lamps of less than 100 watts.

3.4 Lighting—Prescriptive Compliance Alternative

3.4.1 Purpose

3.4.1.1 This subsection provides a prescriptive procedure for determining an exterior lighting power allowance and the Interior Lighting Power Allowances for illumination systems installed in six types of new buildings. It is intended for use with buildings having simple lighting requirements and where the minimum amount of calculation and effort to achieve compliance is of primary concern. For other building types, to receive credit for switching, daylighting, or other trade-offs, or to receive credit for lighting optimization, use Section 3.1 Section 11.0, or Section 12.0.

3.4.1.2 This section also serves as the basis for calculating the skylight area in Section 5.3.9.6, and may be used for estimating the lighting heat gain for calculating the internal load density in Equation 5.4-1 and Section 5.5.6.2.

3.4.2 General

3.4.2.1 This method for compliance prescribes a total allowable Unit Lighting Power Allowance (ULPA) for interior lighting for the building type/area as listed in Table 3.4-1. There is no recognition of specific makeup of spaces and activities within the building.

Table 3.4-1

Prescriptive Unit Lighting Power Allowance (ULPA), W/ft^2

BUILDING TYPE/AREA FUNCTION	Gross Lighted Area Ranges						Effective Date
	0 to 2,000 ft^2	2,001 to 10,000 ft^2	10,001 to 25,000 ft^2	25,001 to 50,000 ft^2	50,001 to 250,000 ft^2	> 250,000 ft^2	
Food Service Fast Food/Cafeteria	1.50 0.92	1.38 0.85	1.34 0.82	1.32 0.81	1.31 0.81	1.30 0.80	1988 1993
Leisure Dining/Bar	2.20 1.60	1.91 1.56	1.71 1.52	1.56 1.48	1.46 1.44	1.40 1.40	1988 1993
Offices	1.90 1.40	1.81 1.34	1.72 1.27	1.65 1.22	1.57 1.16	1.50 1.11	1988 1993
Retail[1] Retail General	3.30 2.70	3.08 2.52	2.83 2.32	2.50 2.05	2.28 1.87	2.10 1.72	1988 1993
Mall Concourse Multi-Store Service	1.60 0.69	1.58 0.68	1.52 0.65	1.46 0.63	1.43 0.61	1.40 0.60	1988 1993
Service Establishment	2.70 2.81	2.37 2.05	2.08 1.78	1.92 1.65	1.80 1.54	1.70 1.46	1988 1993
Garages	0.30 0.25	0.28 0.24	0.24 0.23	0.22 0.22	0.21 0.21	0.20 0.20	1988 1993
Schools Pre-elementary	1.80 1.33	1.80 1.33	1.72 1.27	1.65 1.22	1.57 1.16	1.50 1.11	1988 1993
Jr. High/High School	1.90 1.40	1.90 1.40	1.88 1.39	1.83 1.35	1.76 1.30	1.70 1.26	1988 1993
Technical/Vocational	2.40 1.77	2.33 1.72	2.17 1.60	2.01 1.49	1.84 1.36	1.70 1.26	1988 1993
Warehouse/Storage	0.80 0.60	0.66 0.50	0.56 0.42	0.48 0.36	0.43 0.32	0.40 0.30	1988 1993

Notes:

1. Includes general, merchandising and display lighting.

3.4.3 Exterior Lighting Power Allowance

3.4.3.1 Building exteriors and exterior areas, as defined in Section 3.1.2.2, and roads, grounds, parking, and other exterior areas, defined in Section 3.1.2.3, shall have a lighting power density not to exceed the Exterior Lighting Power Allowance (ELPA), which is the sum of the allowances for each of the areas listed above, as calculated by Equation 3.4-1 using unit power densities from Table 3.4-2.

Table 3.4-2
Exterior Lighting Unit Power Density

AREA DESCRIPTION	UNIT POWER DENSITY (UPD)
Exit (with or without canopy) . . .	25 W/lin. ft of door opening
Entrance (without canopy)	30 W/lin. ft of door opening
Entrance (with canopy)	
High Traffic (retail, hotel, airport, theater, etc.)	10 W/ft^2 of canopied area
Light Traffic (hospital, office, school, etc.)	4 W/ft^2 canopied area
Loading area	0.40 W/ft^2
Loading door	20 W/lin. ft of door opening
Building Exterior Surfaces/Facades	0.25 W/ft^2 of surface area to be illuminated
Storage and non-manufacturing work areas	0.20 W/ft^2
Other activity areas for casual use such as picnic grounds, gardens, parks, and other landscaped areas	0.10 W/ft^2
Private driveways/walkways	0.10 W/ft^2
Public driveways/walkways	0.15 W/ft^2
Private parking lots	0.12 W/ft^2
Public parking lots	0.18 W/ft^2

$$ELPA = \Sigma\ DO_i\ UPD_{Di} + \Sigma\ A_i\ UPD_{Ai} = \Sigma\ [(DO_1 \times UPD_{D1}\ \ldots + DO_n \times UPD_{Dn}) + (A \times UPD_{A1}\ \ldots\ A_n \times UPD_{An})]$$

Equation 3.4-1

Where:

ELPA = Exterior lighting power allowance, in Watts.

i = numerical subscript (1,2, ... n) for each occurrence of exterior openings or exterior areas of the building.

n = total number of occurrences of exterior openings or areas of the building.

DO=Door opening, linear feet.
UPD_D=Unit power density for the door, W/lin. ft, from Table 3.4-2.
UPD_A=Unit power density for the area in W/ft^2, from Table 3.4-2.
A=Exterior area in ft^2.

3.4.4 Interior Lighting Power Allowance

3.4.4.1 The Interior Lighting Power Allowance (ILPA) shall be calculated using the prescriptive Unit Lighting Power Allowances (ULPA) in Table 3.4-1. First, determine if the predominant function of the proposed building is one of the six building types listed in Table 3.4-1. If not, Section 3.5, 11.0, or 12.0 must be used. Next, determine whether the proposed design has secondary functions that are 10% or more of the gross lighted area of the building and are listed in Table 3.4-1. If so, the designer has the option of using the predominant building function to calculate the ILPA or using the calculation method for multiple-use buildings in Section 3.4.4.1.2 below.

3.4.4.1.1 If the proposed building has only one function, has no secondary functions with 10% or more of the gross lighted area, or the designer chooses to determine the ILPA based on only one function, Equation 3.4-2 shall be used to determine the building ILPA. First, select the appropriate building type in Table 3.4-1, and the appropriate column for the Gross Lighted Area (GLA) of the proposed building. This value is the Unit Lighting Power Allowance (ULPA). Determine the ILPA by multiplying the ULPA by the GLA as shown in Equation 3.4-2.

$$ILPA=ULPA \times GLA$$

Equation 3.4-2

Where:
ILPA=Interior Lighting Power Allowance, in Watts.
ULPA=Unit Lighting Power Allowance, in W/ft^2, from Table 3.4-1.
GLA=Gross Lighted Area of the Proposed Building, in ft^2.

3.4.4.1.2 If a building design has more than one function listed in Table 3.4-1, such as an office building with parking and retail stores, with more than 10% of the gross lighted area, Equation 3.4-3 may be used to calculate the building Interior Lighting Power Allowance (ILPA). First, determine the gross lighted area of the building (GLA) and the gross lighted area for each qualifying secondary function (GLA_i) in the building. Select the ULPA from Table 3.4-1 under the column corresponding to the gross lighted area of the entire proposed building and multiply it by the gross lighted area of that function. Sum the products to determine the building ILPA, as shown in Equation 3.4-3 below.

$$ILPA=ULPA_p\ GLA_p+\Sigma\ (ULPA_i\ GLA_i)= [ULPA_p\ GLA_p+(ULPA_{i1}\ GLA_{i1}+ ULPA_{i2}\ GLA_{i2}\ .\ .\ .\ ULPA_{in}\ GLA_{in})]$$

Equation 3.4-3

Where:
i=numerical subscript (1,2, . . . n) for each secondary function with 10% or more of the gross lighted area of the building.
n=number of secondary functions.
ILPA=Interior Lighting Power Allowance, in Watts.
$ULPA_p$=Unit Lighting Power Allowance of the predominant function based on the gross lighted area of the entire building, from Table 3.4-1, in W/ft^2.
$ULPA_i$=Unit Lighting Power Allowance of qualifying secondary functions based on the gross lighted area of the entire building, from Table 3.4-1, in W/ft^2.
GLA_p=Gross lighted area of the predominant function of the proposed building.
GLA_i=Gross lighted area of each qualifying secondary function.

3.4.4.3 *Lighting compliance in partially defined speculative buildings.* For defined functions in partially defined speculative buildings, the total connected lighting power shall not exceed the interior lighting power allowance for that portion of the building. When determining the ILPA for those cases, the gross lighted area of the entire building must be used.

3.5 Lighting—System Performance Compliance Alternative

3.5.1 Purpose

3.5.1.1 This subsection provides a procedure for determining the maximum lighting power allowance for buildings, roads and grounds. It allows the designer to take credit for the use of daylighting and other lighting controls. It also serves as a basis for estimating the lighting heat gain and lighting energy use for Section 5.0.

3.5.2 General

3.5.2.1 The total Connected Lighting Power (CLP) in a building, including permanently installed lighting plus supplemental or task related lighting provided by movable fixtures or plug-in luminaires, shall not exceed the Interior Lighting Power Allowance (ILPA). A Lighting Power Control Credit (LPCC), taken for individual spaces, may only be utilized for credit to connected lighting power in those spaces for which credit is claimed.

3.5.2.2 *Compliance for lighting in partially defined speculative buildings.* The total connected lighting power of lighting designs of defined areas of partially defined speculative buildings shall not exceed the interior lighting power allowance for those areas of the building for which lighting has been designed.

3.5.3 The Lighting Power Budget (LPB) of each interior space shall be determined in accordance with Equation 3.5-1.

$$LPB=(A\times UPD_b\times AF)+LPCC$$

Equation 3.5-1

Where:

LPB=Lighting power budget of the space in watts

A_r=Area of the room at the horizontal lighted working place, ft^2

UPD_b=Base Unit Power Density, W/ft^2 (Table 3.5-1)

AF=Area factor of the room, (Figure 3.5-1)

$LPCC$=Lighting Power Control Credit, as determined by § 3.5.6

3.5.3.1 The room area (A) shall be calculated from the inside dimensions of the room.

3.5.3.2 The Base Unit Power Density (UPD) shall be selected from Table 3.5-1. For applications to areas or activities other than those given, select values for similar areas or activities.

TABLE 3.5-1

BASE UPD (P_b) FOR AREA/ACTIVITY

AREA/ACTIVITY COMMON ACTIVITY AREAS	1989 UPD	1989 NOTE	1993 UPD	1993 NOTE
Auditorium	1.6	(d)	1.4	(d)
Corridor	0.8	(e)	0.8	(e)
Classroom/Lecture Hall	2.0		1.0	
Elec/Mech Equipment Room				
General	0.7	(a)	0.7	(a)
Control Rooms	1.5	(a)	1.5	(a)
Food Service				
Fast Food/Cafeteria	1.3		0.8	
Leisure Dining	2.5	(c)	1.4	(c)
Bar/Lounge	2.5	(c)	1.3	(c)
Kitchen	1.4		1.4	
Recreation/Lounge	0.7		0.5	
Stairs				
Active Traffic	0.6		0.6	
Emergency Exit	0.4		0.4	
Toilet & Washroom	0.8		0.5	
Garage				
Auto/Pedestrian Circulation	0.3		0.25	
Parking Area	0.2		0.2	
Laboratory	2.3		2.2	
Library				
Audio Visual	1.1		1.1	
Stack Area	1.5		1.5	
Card File & Cataloging	1.6		0.8	
Reading Area	1.9		1.0	
Lobby (General)				
Reception & Waiting	1.0		0.55	
Elevator Lobbies	0.8		0.4	
Atrium (Multi-Story)				
First 3 Floors	0.7		0.4	
Each Additional Floor	0.2		0.15	
Locker Room & Shower	0.8		0.6	

AREA/ACTIVITY COMMON ACTIVITY AREAS	1989 UPD	1989 NOTE	1993 UPD	1993 NOTE
Offices				
Enclosed offices of less than 900 ft^2 and all open plan offices w/out partitions or w/partitions lower than 4.5 ft below ceiling.		(h)		(h)
Reading, Typing and Filing	1.8	(g)	1.3	(g)
Drafting	2.6	(g)	2.2	(g)
Accounting	2.1	(g)	1.8	(g)
Open plan offices, 900 ft^2 or larger, w/medium height partitions 3.5 to 4.5 ft below ceiling.		(h)		(h)
Reading, Typing and Filing	1.9	(e)	1.5	(e)
Drafting	2.9	(e)	2.6	(e)
Accounting	2.4	(e)	2.1	(e)
Open plan offices, 900 ft^2 or larger, w/partitions higher higher than 3.5 ft below ceiling.		(h)		(h)
Reading, Typing and Filing	2.2	(e)	1.7	(e)
Drafting	3.4	(e)	3.0	(e)
Accounting	2.7	(e)	2.4	(e)
Common Activity Areas				
Conference/Meeting Room	1.8	(d)	1.3	(d)
Computer/Office Equipment	2.1		2.1	
Filing, Inactive	1.0		1.0	
Mail Room	1.8		1.8	
Shop (Non-Industrial)				
Machinery	2.5		2.5	
Electrical/Electronic	2.5		2.5	
Painting	1.6		1.6	
Carpentry	2.3		2.3	
Welding	1.2		1.2	
Storage & Warehouse				
Inactive Storage	0.3		0.2	
Active Storage, Bulky	0.3		0.3	
Active Storage, Fine	1.0		0.9	
Material Handling	1.0		1.0	
Unlisted Space	0.2		0.2	

TABLE 3.5-1 (Continued)
BASE LPD (P_b) FOR AREA/ACTIVITY

AREA/ACTIVITY SPECIFIC BUILDINGS	1989 LPD	1989 NOTE	1995 LPD	1995 NOTE
Airport, Bus and Rail Station				
Baggage Area	0.8		0.75	
Concourse/Main Thruway	0.9		0.45	
Ticket Counter	2.5		1.3	
Waiting & Lounge Area	1.2		0.6	
Bank				
Customer Area	1.0		0.8	
Banking Activity Area	2.8		2.2	
Barber & Beauty Parlor	2.0		1.6	
Church, Synagogue, Chapel				
Worship/Congregational	2.3		1.3	
Preaching & Sermon/Choir	2.7		1.8	
Dormitory				
Bedroom	1.0		0.6	
Bedroom with Study	1.3		1.3	
Study Hall	1.8		0.9	
Fire & Police Department				
Fire Engine Room	0.7		0.7	
Jail Cell	0.8		0.4	
Hospital/Nursing Home				
Corridor	1.3	(a)	0.9	(a)
Dental Suite/Exam/Treat	1.6		1.4	
Emergency	2.3		2.0	
Laboratory	1.9		1.7	
Lounge/Waiting Room	0.9		0.6	
Medical Supplies	2.4		2.4	
Nursery	2.0		1.6	
Nurse Station	2.1		1.8	
Occu./Physical Therapy	1.6		1.4	
Patient Room	1.4		0.9	
Pharmacy	1.7		1.5	
Radiology	2.1		1.8	
Surgical & O.B. Suites				
General Area	2.1		1.8	
Operating Room	7.0		6.0	
Recovery	3.0		2.0	
Hotel/Conference Center				
Banquet Room/Multipurpose	2.4	(d)	1.4	[illegible]
Bathroom/Powder Room	1.2		0.4	
Guest Room	1.4		0.7	
Public Area	1.1		0.8	
Exhibition Hall	2.6		1.3	
Conference/Meeting	1.8	(d)	1.3	[illegible]
Lobby	1.9		1.3	
Reception Desk	2.4		2.4	
Laundry				
Washing	0.9		0.6	
Ironing & Sorting	1.3		1.3	
Museum & Gallery				
General Exhibition	1.9		1.2	
Inspection/Restoration	3.9		3.0	
Storage (Artifacts)				
Inactive	0.6		0.25	
Active	0.7		0.5	
Post Office				
Lobby	1.1		0.8	
Sorting & Mailing	2.1		2.1	
Service Station/Auto Repair	1.0		0.8	
Theater				
Performance Arts	1.5		1.1	
Motion Picture	1.0		0.75	
Lobby	1.5		1.0	
Retail Establishments (Merchandising & Circulation Area) Applicable to all lighting, including accent and display lighting, installed in merchandising and circulation areas				
Type A	5.6	(e)	6.0	[illegible]
Type B	3.2	(e)	2.9	[illegible]
Type C	3.3	(e)	2.7	[illegible]
Type D	3.0	(e)	2.5	[illegible]
Type E	2.8	(e)	2.4	[illegible]
Type F	2.7	(e)	2.6	[illegible]
Mall Concourse	1.4		0.6	
Retail Support Area				
Tailoring	2.1		2.1	
Dressing/Fitting Rooms	1.4		1.1	

TABLE 3.5-1 (Continued)

BASE UPD (P_b) FOR AREA/ACTIVITY

	1989		1993	
AREA/ACTIVITY INDOOR ATHLETIC AREAS	UPD	NOTE (b)	UPD	NOTE (b)
Seating Area, All Sports	0.4		0.4	
Badminton				
Club	0.5		0.5	
Tournament	0.8		0.8	
Basketball/Volleyball				
Intramural	0.8		0.8	
College	1.3		1.3	
Professional	1.9		1.9	
Bowling				
Approach Area	0.5		0.5	
Lanes	1.1		1.1	
Boxing or Wrestling (platform)				
Amateur	2.4		2.4	
Professional	4.8		4.8	
Gymnasium				
General Exercising & Recreation Only	1.0		1.0	
Handball/Racquetball/Squash				
Club	1.3		1.3	
Tournament	2.6		2.6	
Hockey, Ice				
Amateur	1.3		1.3	
College or Professional	2.6		2.6	
Skating Rink				
Recreational	0.6		0.6	
Exhibition/Professional	2.6		2.6	
Swimming				
Recreational	0.9		0.9	
Exhibition	1.5		1.5	
Underwater	1.0		1.0	
Tennis				
Recreational (Class III)	1.3		1.3	
Club/College (Class II)	1.9		1.9	
Professional (Class I)	2.6		2.6	
Tennis, Table				
Club	1.0		1.0	
Tournament	1.6		1.6	

NOTES:

(a) Area Factor of 1.0 shall be used for these spaces.

(b) Area Factor of 1.0 shall be used for all indoor athletic spaces.

(c) Base UPD includes lighting power required for clean-up purpose.

(d) A 1.5 adjustment factor is applicable for multi-functional spaces

(e) See Section 11.0 - Definitions for Classification of Retail Facilities

(f) These Standards do not prescribe UPD for dwelling units.

(g) Area factor shall not exceed 1.55.

(h) Minimum of 90% of all work stations shall be enclosed with partitions of the height prescribed.

3.5.3.3 The Area Factor (AF) shall be determined from Figure 3.5-1 based on the floor area and ceiling height of the room. Rooms with identical ceiling height and activities, and with similar size may be treated as a group. The AF of such a group of rooms shall be determined from the average area of the rooms.

Equation 3.5-2 gives the formula used in developing Figure 3.5-1.

$$AF = 0.2 + 0.8 \exp. - \left[\left[\frac{10.21 \times (CH - 2.5)}{\sqrt{A_r}} - 1 \right] \times \mathrm{Ln}\,(0.9) \right]$$

Equation 3.5-2

Where:

AF=Area Factor

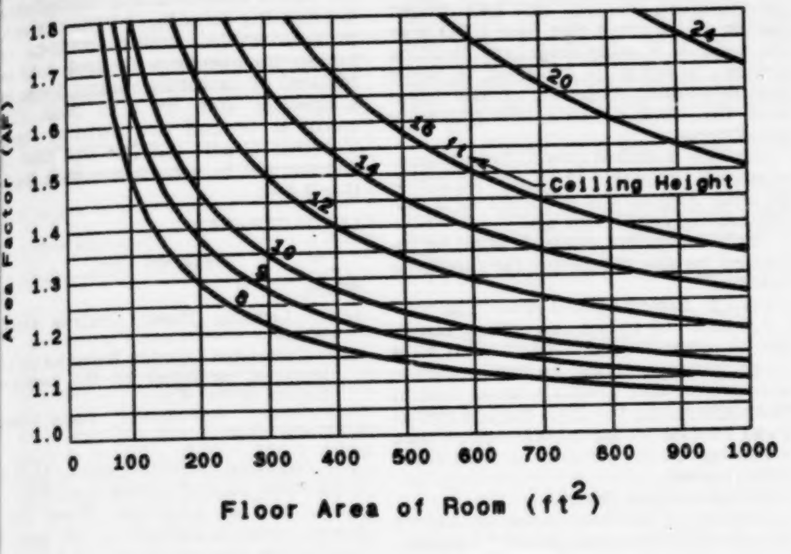
CH=Ceiling Height

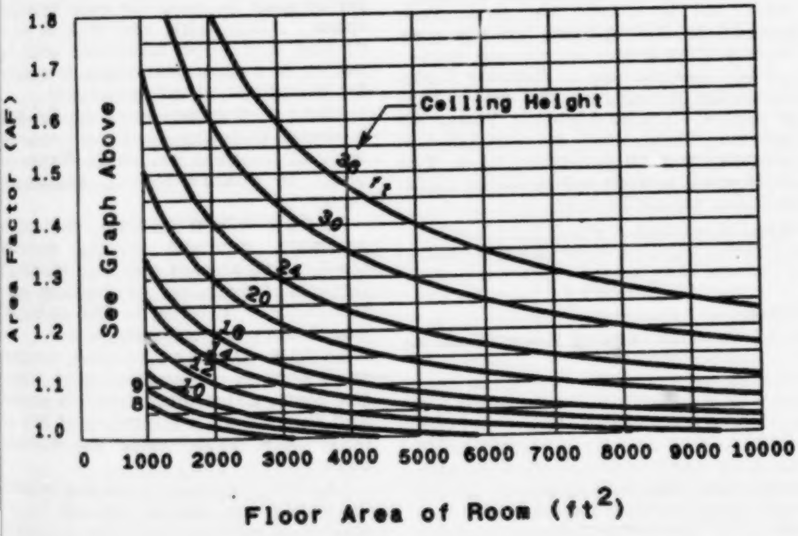
A_r=Floor Area of Room, ft^2

If AF<1.0 then AF=1.0

If AF>1.8 then AF=1.8

Figure 3.5-1 Base Unit Power Density Area Factor





3.5.4 Special Spaces and Activities.

3.5.4.1 Multi-Function Rooms.

3.5.4.1.1 For rooms serving multi-functions, such as hotel banquet/meeting rooms and office conference/presentation rooms, an adjustment factor of 1.5 times the base UPD may be used if a supplementary lighting system is actually installed to serve the secondary function of the room and the design meets the following conditions:

(a) The installed power for the supplementary system shall not be greater than 33% of the adjusted LPB calculated for that room; and

(b) Independent controls shall be installed for the supplementary lighting system.

3.5.4.2 Simultaneous Activities.

3.5.4.2.1 In rooms containing multiple simultaneous activities, such as a large general office having separate accounting and drafting areas within the same room, the LPB for the rooms shall be the weighted average of the activities in proportion to the areas being served.

3.5.4.3 Indoor Sports.

3.5.4.3.1 The floor area of indoor sports activities areas shall be considered as the area within the playing boundaries of the sport, plus the floor area 10 ft beyond the playing boundaries, not to exceed the total floor area of the indoor room less the spectator seating area.

3.5.5 *Calculation of Interior Lighting Power Allowance.* The system performance Interior Lighting Power Allowance (ILPA) shall be calculated in accordance with Equation 3.5-3. The ILPA shall include a 0.20 W/ft² allowance for unlisted spaces.

$$ILPA=(LPB_1\times LS_1+LPB_2\times LS_2 —— LPB_n\times LS_n)+0.2\ W/ft^2\times(\text{Unlisted Space})$$

Equation 3.5-3

Where:

ILPA=Interior Lighting Power Allowance, W/ft²

$$\text{Unlisted space}=(GLA-n\Sigma\ \frac{i-1}{LS_{i-n}),\ ft^2}$$

GLA=Gross Lighted Area, ft²
LPB=Lighting Power Budget, Watts
LS=Listed Space Area, ft²

3.5.6 Lighting Power Contro Credit and Power Adjustment Factor

3.5.6.1 When calculating the ULP in this section, the connected pow for lights automatically controlled b daylighting sensors, occupancy sens programmable timing controls, o lumen maintenance controls may b reduced by factoring control credits o a specific area by area basis. Th credit is termed the Lighting Pow Controls Credit (LPCC) and shall b determined in accordance with Equ tion 3.5-4:

$$LPCC=CLP\times PAF$$

Equation 3.5-4

Where:

LPCC=Lighting Power Controls Cred Watts
CLP=Connected Lighting Power for the lu minaires controlled by the automat control device, Watts
PAF=Power Adjustment Factor, fro Table 3.5-2

The adjusted lighting power (ALP) i then equal to CLP minus the LPCC.

3.5.6.2 The Lighting Power Con trols Credit is limited to the specifi luminaires controlled by the automat ic control device.

3.5.6.2.1 Only one adjustme factor may be used for each buildin space or luminaire, and 50% or mor of the controlled luminaire shall b within the applicable space to qualif for the power adjustment factor.

3.5.6.2.2 Controls shall be installe in series with the lights and in seri with all manual switching devices i order to qualify for an adjustme factor.

3.5.6.2.3 When sufficient daylight i available, daylight sensing contro shall be capable of reducing electric power consumption for lighting, con tinuously or in steps, to 50% or less o maximum power consumption.

3.5.6.2.4 Daylight sensing contro shall control all luminaires to whic the power adjustment factor is applie and that direct a minimum of 50% o their light output into the dayligh zone.

3.5.6.2.5 Occupancy sensors locate in daylighted spaces should be in stalled in conjunction with a manu

ON switch, or photocell override for ON.

3.5.6.2.6 Programmable timing controls used for credit in conjunction with Table 3.5-2 shall be:

Table 3.5-2
Power Adjustment Factor (PAF)

Automatic Control Device(s)	Standard PAF*
(1) Occupancy sensor	0.30
(2) Daylight Sensing continuous dimming	0.30
(3) Daylight Sensing multiple step dimming	0.20
(4) Daylight Sensing ON/OFF	0.10
(5) Lumen maintenance	0.10

*-Power Adjustment Factor cannot be used for incandescent fixtures.

(a) Programmable for different schedules for occupied and unoccupied days;

(b) Accessible for temporary override by occupants of individual zones, spaces or tasks, with automatic return to the original schedules; and

(c) Capable of keeping time during power outages for a minimum of four hours.

§ 435.104 Auxiliary systems and equipment.

4.1 General

This section contains a few minimum requirements for auxiliary systems and equipment. Because auxiliary systems and equipment vary greatly among buildings, the section is not more comprehensive.

4.2 Principles of Design

4.2.1 Energy recovery should be used when coincident thermal and refrigeration loads of similar magnitude are expected.

4.2.2 Consideration shall be given to the use of waste heat, energy recovery or heat tape systems to conserve energy.

4.3 Minimum Requirements

4.3.1 Transportation Systems.

4.3.1.1 Automatic elevator and/or conveyor systems shall incorporate schedule controls and efficient motor controls, such as solid state control devices.

4.3.2 Freeze Protection System.

4.3.2.1 Boilers or water heaters used for purposes such as freeze protection in fire protection storage vessels and defrosting sidewalks and driveways shall meet the efficiency requirements of sections 8.3 or 9.3 when they operate in excess of 750 hours per year.

4.3.3 Retail Food and Food Service Refrigeration.

4.3.3.1 Refrigeration systems containing multiple compressors shall have compressors sized to optimally match capacity with loads.

4.3.3.2 Variable speed shall be considered.

§ 435.105 Building Envelope.

5.1 General

5.1.1 This section contains requirements for the energy conscious design of building envelopes. It sets principles of good envelope design, and provides a set of minimum requirements and two alternative compliance paths—prescriptive and system performance.

5.1.2 *Compliance.* A building shall be considered in Compliance with this section if the following conditions are met:

5.1.2.1 The minimum requirements of Section 5.3 are met;

5.1.2.2 The design of the building envelope complies with either the prescriptive criteria of Section 5.4 or the system performance criteria of Section 5.5. For the design of buildings with high internal heat gains, unusual operating schedules, or that incorporate innovative design strategies, consideration shall be given to using the compliance paths set forth in Sections 11.0 or 12.0.

5.1.3 The prescriptive compliance alternative of Section 5.4 provides requirements for buildings designed to take advantage of perimeter daylighting, thermal mass, high performance glazings, and fenestration shading. The designer is allowed to make tradeoffs between thermal mass, wall insulation, amount of fenestration, shading coefficients, shading projections, thermal transmittance of the glazing, daylighting for several different climate locations.

5.1.4 The systems performance compliance alternative of Section 3.5 provides calculation procedures that give credit for the benefits of more complex energy conserving envelope designs.

5.1.5 Information on thermal properties, performance of building envelope sections and components, and heat transfer shall be obtained from the *ASHRAE Handbook, 1985 Fundamentals Volume*. When information is not available from this source, the data shall be obtained from laboratory or field test measurements conducted in accordance with *ASTM Standard C-177-85*, "Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Guarded Hot Plate," *ASTM Standard C-518-85*, "Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter," *ASTM Standard C-236-80*, "Standard Test Method for Steady-State Thermal Performance of Building Assemblies by Means of a Guarded Hot Box," and *ASTM Standard C-976-82*, "Thermal Performance of Building Assemblies By Means of a Calibrated Hot Box."

5.1.6 *Daylighting Credit*. In this section, daylighting credit for reduced energy use resulting from the use of automatic lighting control devices in conjunction with fenestration, is given only for space heating and cooling loads. Credit for the reduced use of electric lighting energy is calculated in Section 3.5.6. If daylighting credit for reduced electric lighting energy use is desired to be applied to other building systems, such as more fenestration area, Section 11.0 or 12.0 should be used.

5.1.7 The requirements of this section are not intended to replace building loads calculation procedures.

5.2 Principles of Design

5.2.1 Building Loads

5.2.1.1 Building loads result from sources external and internal to the building. (1) External loads, from outdoor temperature, humidity, wind, and insolation, fluctuate daily and seasonally. (2) Internal loads from the activities conducted within the building, including heating and moisture produced by the occupants, lights, and process equipment (e.g., appliances, computers) vary with internal activities. Improving energy efficiency in a building depends on achieving a balance between and among the internal and external loads. The building design should, therefore, offset gains and losses of heat, light, and moisture between the interior and exterior of the building, among interior spaces, and over-time, (daily, seasonally, and annually).

5.2.1.2 This balance of loads can be most efficiently achieved if the building envelope is viewed as, and designed to be, a controlled membrane rather than an immutable barrier. The typical design of a modern building has considered the building envelope to be a fixed barrier that restricts heat and air flow to the maximum extent possible. This will not usually yield the most energy efficient building.

5.2.1.3 The desired goal of the energy design of the building envelope shall be to produce a controlled membrane that allows or prevents heat, light, and moisture flow to achieve a balance between internal and external loads. Thus the envelope becomes an integral part of the building's environmental conditioning systems.

5.2.1.4 To achieve control of the building envelope as a membrane, and to simultaneously achieve occupant comfort in the perimeter zones, many of the traditional building skin components must be used (insulation, mass, caulking and weather stripping). However, other concepts shall also be considered to temper supply air or utilize waste heat in exhaust air to temper envelope conditions, such as operable solar shading devices, and the integration of glazing systems with the HVAC distribution system.

5.2.1.5 Control of External Loads

5.2.1.5.1 Control of Conduction

(a) Controlled conductivity may be considered through the careful use of insulation, sensible (mass) or phase-change storage and movable insulation at levels which minimizes net heating and cooling loads on a time integrated (annual) basis.

(b) Unintentional or uncontrolled thermal bridges shall be minimized and considered in energy related calculations since they can radically alter the conductivity of a building envelope. Examples include wall studs, balconies, ledges, and extensions of building slabs.

5.2.1.5.2 Control of Infiltration (Heat Loss or Gain)

(a) Infiltration shall be minimized and all efforts to achieve a zero level shall be taken. This will minimize fan energy consumption in pressurized buildings during occupied periods and heat loss (or unwanted heat gain in warm climates) during unoccupied periods. Infiltration reduction shall be accomplished through design details that enhance the fit and integrity of building envelope joints in a way that may be readily achieved during building construction. This includes infiltration control by caulking, weather stripping, vestibule doors and/or revolving doors with construction meeting or exceeding accepted specifications.

(b) The quantity of mechanical ventilation must vary with the need, with recommended values at any given time equal to that required by ASHRAE Standard 62-1981. Higher levels of ventilation (e.g., economizers) shall be considered to substitute for mechanical cooling.

(c) Operable windows may be considered to allow for occupant controlled ventilation. When using operable windows, the design of the building's mechanical system must be carefully executed to minimize unnecessary HVAC energy consumption, and building operators must be cautioned about the improper use of the operable windows.

(d) Non-mechanical ventilation can be enhanced in the shape of the building as well as the physical elements of the building envelope, such as cupolas.

(e) For hotels and high rise dwelling units and other systems having exhaust totalling 3000 cfm or more, with annual operation in excess of 3000 hours and within 200 linear ft of simultaneous make-up air equipment, they shall incorporate energy recovery or treatment to ASHRAE 62-1981 quality levels and reuse exhaust air when allowed by code.

5.2.1.5.3 Control of Radiated Heat Losses and Gains

(a) Capability for occupant radiant comfort shall be maintained regardless of whether the building envelope is designed to be a static or dynamic membrane. Opaque surfaces shall be designed so that the *average* inside surface temperatures will remain within 5 °F of room temperature in the coldest anticipated weather (i.e., winter design conditions), and the coldest inside surface will remain within 25 °F of the room temperature.

(b) In a building with time-varying internal heat generation, thermal mass may be considered for controlling radiant comfort. In the perimeter zone, thermal mass is more effective when it is positioned internal to the envelope insulation.

(c) The effective control of solar radiation is critical to the design of energy-efficient buildings due to the high level of internal heat production already present in most commercial building types. In some climates, the lighting energy consumption savings due to daylighting techniques can be greater than the heating and cooling energy penalties from additional glazed surface area, provided that the building envelope is properly designed for daylighting and lighting controls are installed and used. In other climates they may not. Daylighting designs are most effective if direct solar beam radiation is not allowed to cause glare in building spaces.

(d) The transparent portions of the building envelope shall be designed to prevent solar radiant gain above that necessary for effective daylighting and solar heating. On south-facing facades, the use of low shading coefficients is generally not as effective as external physical shading devices in achieving this balance. Light shelves offer a very effective means of admitting daylight while shading the view glazing and simultaneously allowing occupants to manipulate interior shading devices (draperies, blinds) without eliminating day light.

(e) The solar spectrum contains a range of wavelengths including visible and infrared (heat). Designers shall consider which portion of the spectrum to admit into the building. For example, low emissivity, high-visible-transmittance glazings may be considered for the effective control of radiant heat gains and losses. For shading control designers may consider the careful use of vegetation that can block excess gain, year-around or seasonally depending on the plant species chosen.

5.3 Minimum Requirements

5.3.1 Overall Thermal Transmittance (U_o)

5.3.1.1 The overall thermal transmittance of the building envelope above grade assembly shall be calculated as follows:

$$U_o = \Sigma U_i A_i / A_o = (U_1 A_1 + U_2 A_2 + \ldots + U_n A_n) / A_o$$

Equation 5.3-1

Where:

U_o = the area weighted average thermal transmittance of the gross area of the building envelope assembly, e.g., the exterior wall assembly including fenestration and doors; roofs and ceiling assembly; or the floor assembly, Btu/h·ft^2·°F.

A_o = the gross area of the envelope assembly, ft^2.

U_i = the thermal transmittance of each individual path of the envelope assembly (see Section 5.3.2), $U_i = 1/R_i$ (where R_i is the total resistance to heat flow of an individual path through an envelope assembly).

A_i = the area of each individual element of the envelope assembly, ft^2.

5. 3. 2 *Thermal Resistance of Below Grade Components* (*R*)

5.3.2.1 In calculating the thermal resistance of all below grade components, the thermal performance of the adjacent ground shall be excluded.

5.3.2.2 *Slabs*

5.3.2.2.1 The R-value required for slabs refers only to the insulation materials. Insulative continuity shall be maintained in the design of slab edge insulation systems. Continuity shall be maintained from the wall insulation through the slab/wall/footing intersection to the body of the slab edge insulation.

5.3.2.2.2 Slab-on-grade floors shall have insulation around the perimeter of the floor with the thermal resistance (R_o) of the insulation specified in accordance with Figure 5.5-2. The slab insulation specified shall extend either in a vertical plane downward from the top of the slab for the minimum distance shown or downward to the bottom of the slab then in a horizontal plane beneath the slab or outward from the building for the minimum distance shown. The horizontal length, or vertical depth, of insulation required varies from 24 in. to 48 in. depending upon the R-value selected. For heated slabs, an R of 2 shall be added to the thermal resistance required.

5.3.2.2.3 Vertical insulation shall not be required to extend below the foundation footing. There are no insulation requirements for slabs in locations having less than 3,000 HDD65 or for footings extending less than 18 in. below grade.

5.3.2.2.4 The dimensional requirements for horizontal insulation refer to the insulation materials only. Horizontal applications shall have a thermal break in the slab edge that provides continuity between the wall insulation on the slab and the horizontal insulation.

Below Grade Walls

5.3.2.3.1 The R-value required for Below Grade Walls refers to the overall R-value of the wall assembly excluding air film coefficients and the thermal performance of the adjacent ground.

5.3.3 Thermal Transmittance (U_i) of an Envelope Assembly

5.3.3.1 The thermal transmittance of each envelope assembly shall be determined with due consideration of all major series and parallel heat flow paths through the elements of the assembly. Compression of insulation shall be considered in determining the thermal resistance.

5.3.3.2 The thermal transmittance of opaque assemblies U_i shall be determined using a series path procedure that corrects parallel paths, such as insulation and studs in a wall cavity or the roof assembly shown in Figure 5.3-1. Table 5.3-1 prescribes the procedure to be used for Subsections 5.3.3.2.1 and 5.3.3.2.2.

Figure 5.3-1
Example of Total Resistance of an Envelope Assembly Including Series Resistance and Parallel Path Equivalent Resistance Elements

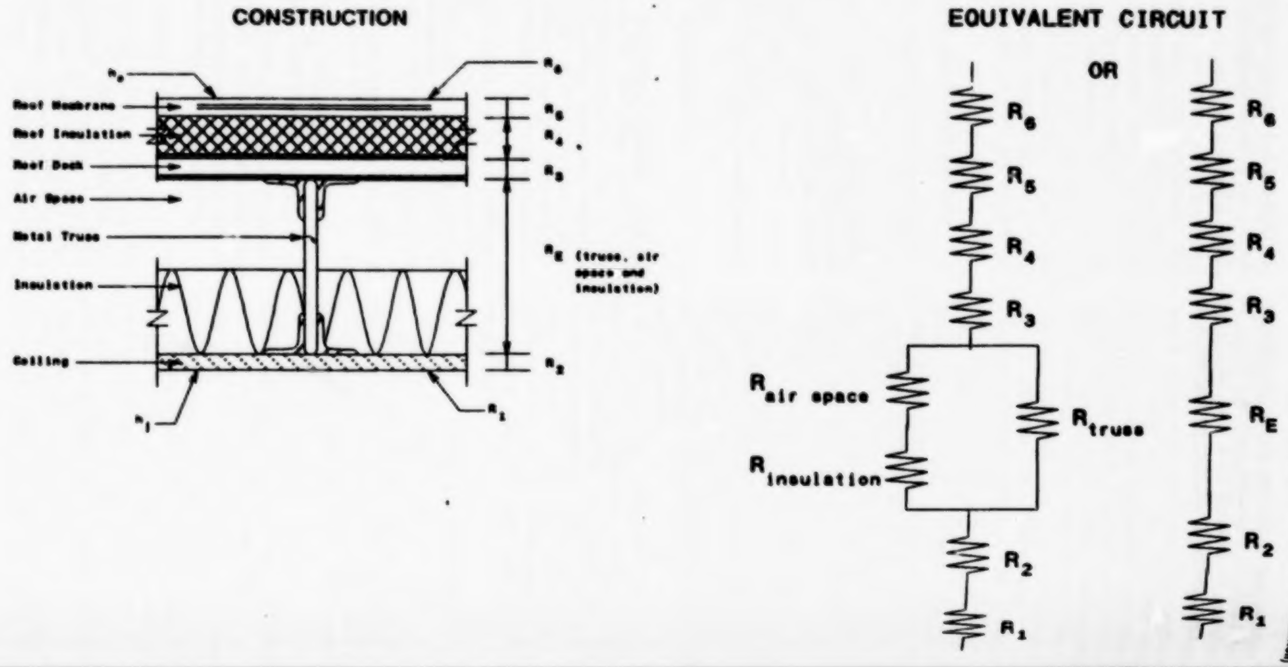

CONSTRUCTION
EQUIVALENT CIRCUIT
R_o
R_i
Roof Membrane
Roof Insulation
Roof Deck
Air Space
Metal Truss
Insulation
Ceiling
R_6
R_5
R_4
R_3
R_E (truss, air space and insulation)
R_2
R_1
OR
R_air space
R_insulation
R_truss
R_E

Table 5.3-1

Calculation Procedures for Thermal Transmittance Through Opaque Envelope Assemblies

Material Attached To Thermal Bridge Material	Thermal Bridge Material	Calculation Procedure(s)
Metal	Metal	Thermal Bridges Sheet Metal Construction, 5.3.3.2.1 (d)
Metal	Non-Metal	Parallel/Series 5.3.3.2.2
Non-Metal	Metal	Case Specific Correction 5.3.3.2.1 (b), or 5.3.3.2.1 (c)
Non-Metal	Non-Metal	Parallel/Series 5.3.3.2.2

5.3.3.2.1 For envelope assemblies containing metal framing, the U_t shall be determined by using one of the following methods:

(a) Results from laboratory or field test measurements, using one of the procedures specified in Section 5.1.5.

(b) For non-metal surfaces attached to metal framing, where data from tests conducted using procedures specified in Section 5.1.5, such as those provided in Tables 5.3-2 and 5.3-3, is available, the total resistance of the series path may be calculated using Equations 5.3-2a and 5.3-2b, and illustrated in Figure 5.3-1:

Table 5.3-2

Parallel Path Correction Factors[1]

Bridged R-Value	0	5	10	15	20	25	30	35	40	45	50	55
Correction Factor	1.0	0.96	0.92	0.88	0.85	0.81	0.79	0.76	0.73	0.71	0.69	0.67

[1] Table 5.3-2 values are based upon metal trusses with 4 ft spacing that penetrate the insulation, and 0.66 in. diameter crossmembers every 1 ft.

Table 5.3-3

Wall Sections With Metal Stops

Parallel Path Correction Factors

Size of Members	Gauge of Stud	Spacing of Framing, In.	Cavity Insulation R-Value	Correction Factor
2 X 4	18-16	16 o.c.	R-11	0.50
2 X 4	18-16	24 o.c.	R-11	0.60
2 X 6	18-16	16 o.c.	R-19	0.40
2 X 6	18-16	24 o.c.	R-19	0.45

$$U_t = 1/R_t$$

Equation 5.3-2a

$$R_t = R_i + R_e$$

Equation 5.3-2b

Where:

R_t = the total resistance of the envelope assembly
R_i = the resistance of the series elements (for i=1 to n), excluding the parallel path element(s)
R_e = the equivalent resistance of the element containing the parallel path, the value of R_e is:
R_e = (R-value of insulation) × F_c

Equation 5.3-2c

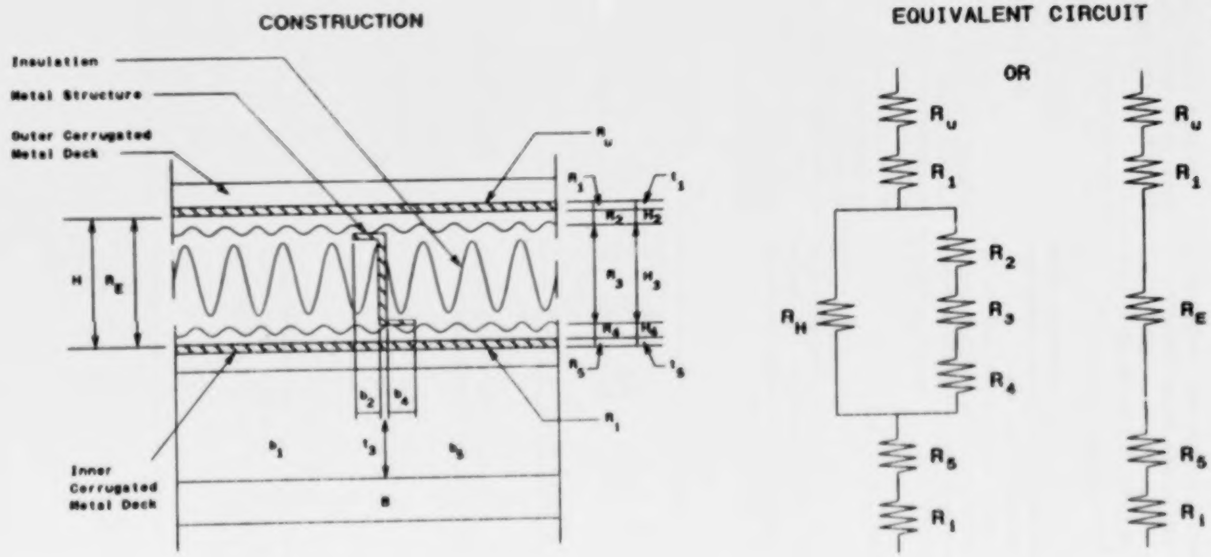
Where:

F_c = the correction factor from Table 5.3-2 or Table 5.3-3.

(c) For elements other than those covered in item (b) above, the zone method described in Chapter 23 of the *ASHRAE Handbook, 1985 Fundamentals Volume* shall be used. The equations on pages 23.13 and 23.14 shall be used.

(d) For sheet metal construction, internally insulated with an internal metal structure bonded on one or both sides to a metal skin or covering (see Figure 5.3-2), the following steps shall be used to calculate the U-value of the envelope construction.

Figure 5.3-2
A Generalized Built-Up Sheet Metal
Construction and Corresponding Resistance Network


CONSTRUCTION
EQUIVALENT CIRCUIT
Insulation
Metal Structure
Outer Corrugated Metal Deck
Inner Corrugated Metal Deck
H
R_E
R_u
R_1
t_1
R_2
H_2
R_3
H_3
R_4
H_4
R_5
t_5
R_i
b_2
b_4
b_1
t_3
b_5
B
OR
R_H
R_u
R_1
R_2
R_3
R_4
R_5
R_i
R_u
R_1
R_E
R_5
R_i

(1) First, calculate the resistance of the thermal bridge R_{TB} as follows:

$$R_{TB} = R_1 + R_2 + R_3 + R_4 + R_5$$

Equation 5.3-3

(i) Where R_1, the effective mean flow path along the outer metal surface, is calculated by:

$$R_1 = \frac{1}{2 \times L \sqrt{h_1 k_1 T_1}} - \frac{1}{B \times L \times h_1}$$

Equation 5.3-4

(ii) And if it occurs, the resistance of insulation (R_2) between the outer metal surface and the metal structural member is calculated by:

$$R_2 = \frac{1}{k \times L \left[\frac{b_2}{H_2} + \frac{2}{\pi} \right]}$$

Equation 5.3-5

(iii) And, the resistance of the structural member (R_3) is calculated by:

$$R_3 = \frac{h_3}{L \times t_3 \times k_3}$$

Equation 5.3-6

(iv) And if it occurs, the resistance of insulation (R_4) between the inner metal surface and the purlin flange is calculated by:

$$R_4 = \frac{1}{k \times L \left[\frac{b_4}{H_4} + \frac{2}{\pi} \right]}$$

Equation 5.3-7

(v) And finally, the effective mea flow path along the inner metal su face (R_5) is calculated by:

$$R_5 = \frac{1}{2 \times L \sqrt{h_5 k_5 T_5}} - \frac{1}{B \times L \times h}$$

Equation 5.3-8

Where:
L=total length
h=coefficient of heat transfer
k=thermal conductivity
T=temperature
B=total width
H=partial height
t=thickness of sheet metal

(2) Then calculate the parallel pa resistance of the homogeneous insula tion R_H as follows:

$$R_H = \frac{\Sigma \left[\frac{H}{K} \right]}{B \times L}$$

Equation 5.3-9

(3) Then obtain the overall constru tion resistance R_C by combining R and R_{TB} as two parallel resistances:

$$R_C = \frac{R_{TB} \times R_H}{R_{TB} + R_H}$$

Equation 5.3-10

(4) Then add the inside and outsi surface resistances R_i and R_o to g the total resistance R_{TOT}:

$$R_{TOT}=R_C+R_i+R_o$$

Equation 5.3-11

(5) The total area resistance m_{TOT} is then calculated by:

$$m_{TOT}=R_{TOT}\times B\times L$$

Equation 5.3-12

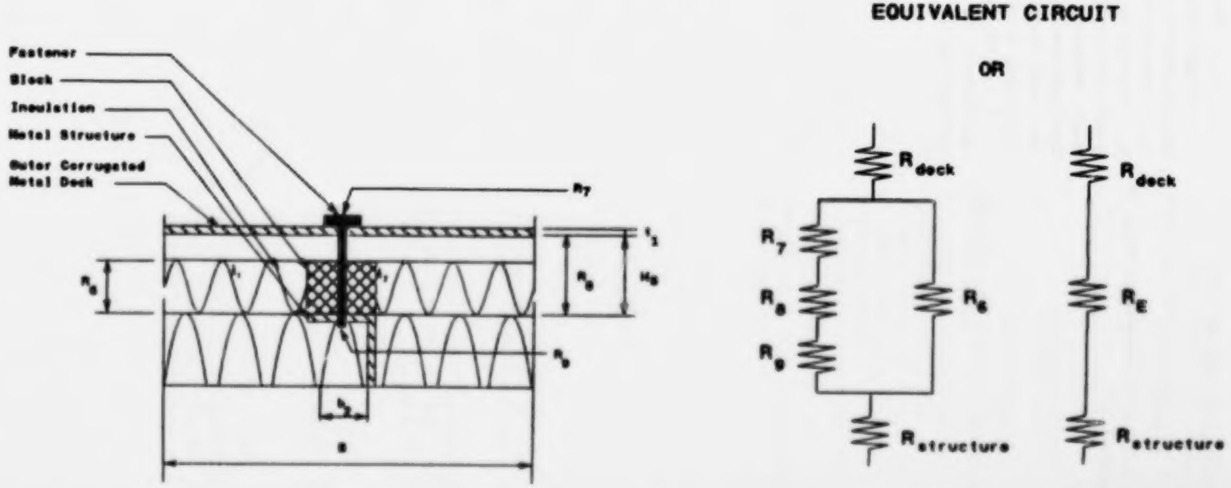
(6) And finally, obtain the U-value by:

$$U=\frac{1}{m_{TOT}}$$

Equation 5.3-13

(7) Where additional resistances are introduced in the construction, introduce them in lieu of the above (R_1 and R_2) resistances. An example of this would be the calculation of both a metallic fastener and a block of higher thermal conductivity material between the outer sheet metal and the internal structural member as shown in Figure 5.3-3. In this case the original R_1 is recalculated by first calculating the thermal bridge R_{1TB} as follows:

Figure 5.3-3
Detail of Heat Transfer From a Metal Surface to a Structure Through a Metal Fastener and Insulating Block With Corresponding Resistance Network


EQUIVALENT CIRCUIT
OR
Fastener
Block
Insulation
Metal Structure
Outer Corrugated Metal Deck
R7
t1
R6
R8
H8
R9
b2
a
R deck
R7
R8
R9
R6
R structure
R deck
R E
R structure

$R_{ers} = R_f + R_s + R_e$

Equation 5.3-14

(i) Where the resistance of the heads of number (N) of fasteners per length (L), adjusting for surface resistance in common with the sheet metal surface, is calculated by:

$$R_f = \frac{1}{N \times 2 \times \pi \times \lambda_1 \times t_1 \times f(\beta r_1, \infty)} - \frac{1}{a_s \times B \times L}$$

Equation 5.3-15

Where:

N=the number of fasteners in Length L

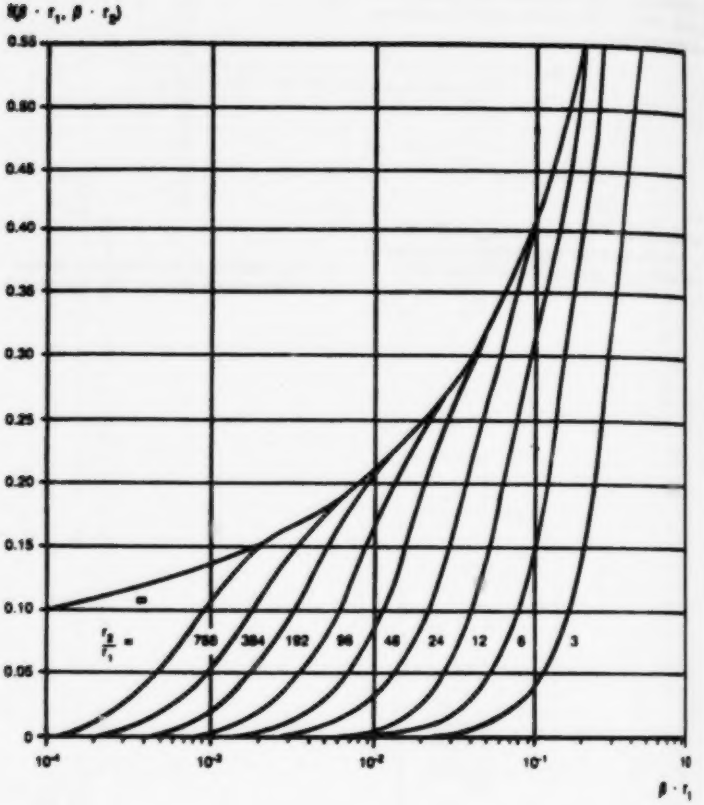
f=the function of B r for different values of the ratio r_2/r_1 given in Figure 5.3-4.

$$\beta = \surd = \frac{\surd\ h}{\lambda x t}$$

r_1=the radius of the fastener shank.

r_2=the outer radius of the fastener head.

Figure 5.3-4 - The Function (f) Given as a Function of βr and for Differ
Values of the Ratio, r_1/r_2



(ii) And, the resistance of the shank of the fastener is calculated by:

$$R_4 = \frac{H_4}{N \times \lambda \times \pi \times r^2_1}$$

Equation 5.3-16

(iii) And, finally, the resistance of the connection to the internal structural member is calculated by:

$$R_9 = \frac{l_n \times \overset{b_2}{r_1}}{N \times 2\pi\lambda \times t}$$

Equation 5.3-17

(iv) Then calculate the resistance of the block of higher thermal conductivity material as follows:

$$R_6 = \frac{1}{L_1 \left[\lambda_1 \frac{b}{H_8} + \lambda_2 \frac{2}{\pi} \right]}$$

Equation 5.3-18

Where:

λ, λ_1

(v) Then obtain the resistance to be used in lieu of the original R_s by:

$$R_s = \frac{R_{TS} \times R_4}{R_{TS} + R_4}$$

Equation 5.3-19

5.3.3.2.2 For envelope assemblies containing Non-Metal Framing, the U_i shall be determined from one of the laboratory or field test measurements specified in Section 5.1.5 or from the ASHRAE series-parallel method. Formulas in Chapter 23, page 23.2 of the *ASHRAE Handbook, 1985 Fundamentals Volume*, shall be used for these calculations.

5.3.3.3 The thermal transmittance of fenestration assemblies shall be corrected to account for the presence of sash, frames, edge effects and spacers in multiple-glazed units.

If thermal transmittances of sash and frames are known, Equation 5.3-1 shall be used, otherwise the thermal transmittance offenestration assemblies shall be calculated as follows:

$$U_{af} = \Sigma\, U_{gi} \times F_{f,i} \times A_i / A_{af} = (U_{g,1} \times F_{e,1} \times A_1 + U_{g,2} \times F_{f,2} \times A_2 + \ldots + U_{g,n} \times F_{f,n} \times A_n)/A_{af}$$

Equation 5.3-20

Where:

A_i=area of i^{th} fenestration assembly

i=numerical subscript (1,2, . . . n) refers to each of the various fenestration assemblies present in the wall

n=the number of fenestration assemblies in the wall assembly.

U_{af}=the overall thermal transmittance of the fenestration assembly, including sash and frames, Btu/h·ft²°F.

U_g=the thermal transmittance of the central area of the fenestration excluding edge effects, spacers in multiple-glazed units, and the sash and frame, Btu/h·ft²°F.

$F_{f,i}$=framing adjustment factor for sash, frames, etc.

A_{af}=the area of all fenestration including glazed portions, sash, frames, etc.

5.3.3.3.1 Values for U_g shall be the winter value obtained from the glazing manufacturer's test data or from Table 13 or Figure 14 of Chapter 27 of the *ASHRAE Handbook, 1985 Fundamentals Volume.* Values for F_f shall be obtained from the frame manufacturer's test data or from the average adjustment factor for a particular product in Table 13, Part C, in Chapter 27 of the *ASHRAE Handbook, 1985 Fundamentals Volume.* For glass products with a U value of 0.45 or less, use the F_f for triple insulated glazing. Alternatively, values of the U_g*F product may be used from manufacturer's test data for open window and frame assemblies tested as a unit provided that the tests referenced edge-effects and windspeed are accounted for winter tested U-values are used.

5.3.4 Gross Area of Envelope Components

5.3.4.1 The gross area of a roof assembly consists of the total surface of the roof assembly exposed to outside air or unconditioned spaces. The roof assembly shall include all roof/ceiling components through which heat may flow between indoor and outdoor environments including skylight surfaces, but excluding service openings.

5.3.4.1.1 For thermal transmittance purposes, when return air ceiling plenums are employed, the roof/ceiling assembly shall not include the thermal resistance of the ceiling, or the plenum space, as part of the total thermal resistance of the assembly.

5.3.4.2 The gross area of a floor assembly over outside or unconditioned space consists of the total surface of the floor assembly exposed to the outside air or an unconditioned space. The floor assembly shall include all floor components through which heat may flow between indoor and outdoor or unconditioned space environments.

5.3.4.3 The gross area of exterior walls enclosing a heated or cooled space is measured on the exterior and consists of the opaque wall including between floor spandrels, peripheral edges of flooring, window areas including sash and door areas, but excluding vents, grilles and pipes.

5.3.5 Shading Coefficients

5.3.5.1 The Shading Coefficient (SC) for fenestration shall be obtained from Chapter 27 of the *ASHRAE Handbook, 1985 Fundamentals Volume* or from manufacturers' test data. For the prescriptive or system performance envelope compliance calculations in Sections 5.4 and 5.5, a factor, SC_x, is used. SC_x is the Shading Coefficient of the fenestration, including internal and external shading devices, but excluding the effect of external shading projections, which is calculated separately. The shading coefficient used for louvered shade screens shall be determined using a profile angle of 30°, as found in Table 41, Chapter 27 of the *ASHRAE Handbook, 1985 Fundamentals Volume*.

5.3.6 Wall Heat Capacity

5.3.6.1 Heat capacity in Btu/°F·ft^2, shall be determined as the product of the average wall weight in lb/ft^2 and the weighted average specific heat of the wall component in Btu/lb·°F.

5.3.6.2 If the wall system is defined as having exterior insulation only the properties of the wall elements inside of the insulation layer shall be used in determining the wall heat capacity.

5.3.6.3 For walls with integral insulation, all of the elements of the entire wall system may be used in the calculation of the wall heat capacity.

5.3.7 Air Leakage and Moisture Migration

5.3.7.1 The requirements of this subsection apply only to those locations separating the outdoors from interior building conditioned space. Compliance with the criteria for air leakage through building components shall be determined by *ASTM E 283-1984*, "Standard Method of Test Rate of Air Leakage Through Exterior Windows, Curtain Walls and Doors."

5.3.7.2 Air Leakage Requirements for Fenestration and Doors

5.3.7.2.1 Fenestration meeting the following standards for air leakage is acceptable:

(a) *ANSI/AAMA 101-85*, "Aluminum Prime Windows."

(b) *ASTM D-4099-83*, "Specification for Poly(VinylChloride) (PVC) Prime Windows."

(c) *ANSI/NWMA I.S. 2-80*, "Wood Window Units (Improved Performance Rating Only)."

5.3.7.2.2 Sliding Doors shall meet one of the following standards for air leakage:

(a) *ANSI/AAMA 101-85*, "Aluminum Sliding Glass Doors."

(b) *NWMA I.S. 3-83*, "Wood Sliding Patio Doors."

5.3.7.2.3 Commercial entrance swinging or revolving doors shall limit air leakage to a rate not to exceed 1.25 cfm/ft^2 of door area, at standard test conditions.

5.3.7.2.4 Residential swinging doors shall limit air leakage to a rate not to exceed 0.5 cfm/ft^2 of door area, at standard test conditions.

5.3.7.2.5 Where spaces have regular high volume traffic through the building envelope, such as retail store entrances and loading bays, estimates of air leakage for HVAC system design shall be based on air exchange by traffic flow.

5.3.7.2.6 To reduce infiltration due to stack-effect draft in multi-story buildings, the use of vestibules or revolving doors on all primary entries and exits shall be considered.

5.3.7.3 Air Leakage Requirements for Exterior Envelope Joints and Penetrations.

5.3.7.3.1 Exterior joints, cracks, and holes in the building envelope, such as those around window or door frames, between wall and foundation, between wall and roof, through wall panels at penetrations of utility services or other service entry through walls, floors, and roofs, between wall panels, particularly at corners and changes in orientation, between wall and floor, where floor penetrates wall, around penetrations of chimney, flue vents, or attic hatches, shall be caulked, gasketed, weather stripped, or otherwise sealed.

5.3.7.4 Moisture Migration Requirements for Exterior Envelopes

5.3.7.4.1 The building envelope shall be designed to prevent moisture migration that leads to deterioration in insulation performance of the building.

5.3.7.4.2 Vapor retarders shall be considered to prevent moisture from collecting within the envelope. Designs should incorporate the principles of *ASHRAE Handbook, 1985 Fundamentals Volume*, Chapter 21, "Moisture in Building Construction."

5.3.8 Shell Buildings

5.3.8.1 The following conditions shall be assumed if determination of building envelope compliance occurs prior to the determination of lighting power density, equipment power density, or fenestration shading device characteristics:

5.3.8.1.1 *Lighting Power Density and Equipment Power Density.* For Section 5.4, the total power density shall be assumed to be those listed in Table 5.3-4. For Section 5.5, the values in Table 5.3-4 shall be assumed to be apportioned as ⅘ lighting and ⅕ for other equipment. Note that these are not recommended design values, but are for compliance purposes only.

Table 5.3-4

Assumed Internal Loads for Shell And Speculative Buildings

	HDD65<3000	3000<HDD65<6000	HDD65>6000
Shell Buildings	3.0 W/ft^2	2.25 W/ft^2	1.50 W/ft^2
Speculative Buildings	Use the LPDs from Table 5.4-1 and the average equipment power density from Table 5.4-32.		

5.3.8.1.2 *Fenestration shading devices.* Only those shading devices that are part of the design when it is being evaluated for compliance shall be considered when determining compliance.

5.3.8.1.3 *Daylighting controls for electric lighting.* Only those controls that are part of the design when it is being evaluated for compliance shall be considered when determining compliance.

5.3.9 Buildings Located in Climates With Greater Than 15,000 HDD Base 65 °F.

5.3.9.1 For locations with a heating degree-day base (HDD) 65 °F greater than 15,000, the envelope criteria listed in Table 5.3-5 shall apply, and the window wall ratio (WWR) shall be less than or equal to 0.20.

Table 5.3-5

Requirements For Locations With

Heating Degree-Days Base 65 °F Greater Than 15,000

Envelope Statement	Maximum U Value	Minimum R Value	Notes
U_o opaque wall for buildings with $\geq$ 12,000 ft^2 of gross floor area [1,3]	0.053		See 5.3.3.2
U_o opaque wall for buildings with < 12,000 ft^2 of gross floor area [2,3]	0.040		
U fenestration	0.450		Use Eq 5.3-2
U roof	0.024		
Floor over unconditioned spaces[4]	0.023		See 5.3.3.2
Wall below grade[5]		18	

Slab-on-grade:

Position	Minimum Insulation Distance, in.	Minimum R Value Unheated Slab	Minimum R Value Heated Slab
Horizontal	48	15	17
Vertical	48	6	8

Skylights: Not allowed for locations with HDD65 greater than 15,000.

Footnotes for Table 5.3-5:

1. For window to wall ration, WWR $\leq$ 0.20. Shall include corrections for parallel paths within the envelope assembly. For WWR > 0.20, see Footnote (3).
2. For window to wall ratio, WWR $\leq$ 0.15. Shall include corrections for parallel paths within the envelope assembly. For WWR > 0.15, see Footnote (3).
3. The window to wall ratio and the stated U-values for opaque wall and fenestration may be increased or decreased provided that the combined thermal wall transmittance shall not exceed 0.125 for buildings $\geq$ 12,000 ft^2, and 0.0 for buildings < 12,000 ft^2.
4. Including pile-supported floors and elevated floors.
5. Installed on the exterior of perimeter foundation walls for heated foundations.

5.3.10 Daylight Credits for Skylights.

5.3.10.1 Skylights used in conjunction with automatic lighting controls for daylighting can significantly reduce the lighting energy consumption, thereby more than offsetting the increase in envelope heat transfer.

5.3.10.2 When determining building roof compliance, daylight credits for skylights may be used if the criteria of this subsection are met.

5.3.10.3 Skylights for which daylight credit is taken may be excluded from the calculation of the overall thermal transmittance value (U_{or}) of the roof assembly, if all of the following conditions are met:

5.3.10.3.1 The opaque roof thermal transmittance U_{or} value does not exceed the value determined within the selected Alternate Component Package (ACP) table for the prescriptive method or by Equation 5.5-1 for the systems performance method.

5.3.10.3.2 Skylight areas, including framing, as a percentage of the roof area do not exceed the values specified in Tables 5.3-6A and 5.3-6B for building sites located within the climate ranges listed in the two Tables, where Visible Light Transmittance (VLT) is the transmittance of a particular glazing material over the visible portion of the solar spectrum. Skylight areas shall be interpolated between visible light transmittance values of 0.75 and 0.50, only.

Table 5.3-6a

(VLT = 0.75)

Maximum Percent Skylight Area for Given Conditions of Lighting Power Density, Light Level (fc), HDD65 and CDH80

BUILDING LOCATION		LIGHT LEVEL IN (fc)	Range of Lighting Power Density (W/ft^2)				
HDD65	CDH80		<1.00	1.01-1.50	1.51-2.00	2.01-2.50	>2.50
0-3000	0-10000	30	2.3	3.1	3.9	4.7	4.7
		50	3.1	4.3	5.5	6.7	6.7
		70	4.3	5.5	6.7	7.9	7.9
0-3000	>10000	30	2.2	2.8	3.4	4.0	4.0
		50	2.3	3.1	3.9	4.7	4.7
		70	2.9	4.1	5.3	6.5	6.5
>3000	ALL	30	2.3	3.4	4.5	5.6	5.6
		50	2.5	4.0	5.5	7.0	7.0
		70	2.8	4.6	6.4	8.2	8.2

Table 5.3-6b
(VLT = 0.50)
Maximum Percent Skylight Area for Given Conditions of Lighting Power Density, Light Level (fc), HDD65 and CDH80

BUILDING LOCATION		LIGHT LEVEL IN FC	Range of Lighting Power Density (W/ft^2)				
HDD65	CDH80		<1.00	1.0-1-1.50	1.51-2.00	2.01-2.50	>2.50
0-3000	0-10000	30	3.6	4.8	6.0	7.2	7.2
		50	4.8	6.6	8.4	10.2	10.2
		70	6.6	8.4	10.2	12.0	12.0
0-3000	>10000	30	3.3	4.2	5.1	6.0	6.0
		50	3.6	4.8	6.0	7.2	7.2
		70	4.2	6.0	7.8	9.6	9.6
>3000	ALL	30	3.6	5.1	6.6	8.1	8.1
		50	3.9	6.0	8.1	10.2	10.2
		70	4.2	6.9	9.6	12.3	12.3

5.3.10.3.3 The skylight area associated with daylight credit can be taken as the area under each skylight whose dimension in each direction (centered on the skylight) is equal to the skylight dimension in that direction plus a distance equal to the floor to ceiling height.

5.3.10.3.4 Skylight areas that overlap areas that have already taken daylight credit (perimeter window areas or other skylight areas) do not again take daylight credit.

5.3.10.3.5 All electric lighting fixtures within skylight areas are controlled by daylight-activated automatic lighting controls.

5.3.10.3.6 For buildings located in climates that have less than 8000 HDD65, the overall thermal transmittance of the skylight assembly, including framing, is less than or equal to 0.7 Btu/h·ft ^{2}·°F. For locations greater than 8000 HDD65, the overall thermal transmittance of the skylight assembly, including framing, is less than or equal to 0.45 Btu/h·ft ^{2}·°F.

5.3.10.3.7 Skylight curbs have thermal transmittance (U) values no greater than 0.21 Btu/h·ft ^{2}·°F.

5.3.10.3.8 The infiltration coefficient of the skylights does not exceed 0.05 cfm/ft ^{2}.

5.3.10.4 Skylight areas in Tables 5.3-6A and 5.3-6B may be increased by 50% if a shading device is used that blocks over 50% of the solar gain during the peak cooling design condition.

5.3.10.5 Areas for vertical glazing in clerestories and roof monitors shall be included in the wall fenestration calculation.

5.3.10.6 For shell buildings, the permitted skylight area from Tables 5.3-6A and 5.3-6B shall be based on a light level of 30 fc and a lighting power density (LPD) of less than 1 W/ft ^{2}.

5.3.10.7 For speculative buildings, the permitted skylight area from Tables 5.3-6A and 5.3-6B shall be based on the unit lighting power allowance from Table 3.4-1 and an illuminance level as follows:

5.3.10.7.1 For LPD less than or equal to 1.0 W/ft ^{2}, use 30 fc;

5.3.10.7.2 For LPD greater than 1.0 W/ft ^{2} and less than 2.5 W/ft ^{2}, use 50 fc; and

5.3.10.7.3 For LPD greater than 2.5 W/ft ^{2}, use 70 fc.

5.3.10.8 Buildings with roof assembly devices that cannot be evaluated under this subsection shall be evaluated using the Building Energy Compliance Methods of Section 11.0 or 12.0.

5.4 Building Envelope—Prescriptive Compliance Alternative

5.4.1 General.

5.4.1.1 This section provides a simple compliance path using precalculated prescriptive requirements for selected exterior envelope configurations of new buildings.

5.4.1.2 The Alternate Component Packages (ACP), found in this subsection, provide design criteria for use with the following options:

5.4.1.2.1 "Base Case"—buildings with envelopes designed without perimeter daylighting.

5.4.1.2.2 "Perimeter Daylighting"—buildings with envelopes that use additional fenestration area by incorporating automatic lighting controls in the perimeter zone to permit the use of daylighting in lieu of electric lighting. This ACP is not available for those climates that do not usually require space cooling by means of mechanical refrigeration.

(a) This daylighting credit is in addition to the increased lighting power allowance provided in Section 3.5. Some perimeter daylighting options allow a greater proportion of fenestration area due to the increased visible and decreased thermal transmittances of high performance glazings in combination with automatic lighting controls.

5.4.1.3 Each ACP provides a limited number of complying combinations of building variables for a set of climate ranges. The criteria, such as maximum percent fenestration, were calculated using the system performance criteria of Section 5.5. Values were chosen from within climate and other variable ranges for the most restrictive results, to ensure compliance of any combination of values within those ranges. Thus, for most climate locations and envelope parameters, the prescriptive criteria may be slightly more stringent than the system performance criteria of Section 5.5.

5.4.1.4 Both the base and perimeter daylight cases have two or three fenestration U-value ranges depending on the climate.

5.4.2 Compliance.

5.4.2.1 The envelope design of the building being evaluated is in compliance with the prescriptive criteria of this section provided that:

5.4.2.1.1 The minimum requirements of Section 5.3 are met.

5.4.2.1.2 All envelope thermal transmittance (U) values are less than or equal to those chosen from the ACP Table selected for roofs, opaque walls, walls next to unconditioned spaces, and floors over unconditioned spaces.

5.4.2.1.3 The percentage of fenestration of the combined gross wall area is less than or equal to the value permitted for internal load range and glazing in the selected ACP Table.

5.4.2.1.4 Slab-on-grade floors have insulation around the perimeter of the floor with the thermal resistance (R_s) of the insulation as listed in the ACP table. The slab insulation specified shall extend either in a vertical plane downward from the top of the slab for the minimum distance shown or downward to the bottom of the slab then in a horizontal plane beneath the slab or outward from the building for the minimum distance shown. The horizontal length, or vertical depth, of insulation required varies from 24 in. to 48 in. depending upon the R-value selected. For heated slabs, an R of 2 shall be added to the thermal resistance required.

(a) Vertical insulation shall not be required to extend below the foundation footing.

(b) There are no insulation requirements for slabs in locations having less than 3,000 HDD65 or for footings extending less than 18 in. below grade.

5.4.2.1.5 The thermal resistance of the below-grade wall assembly must be greater than or equal to that listed in the ACP table, or the heat loss calculated in accordance with Chapter 25 of the *ASHRAE Handbook, 1985 Fundamentals* shall be less than or equal to that of a wall below grade having a thermal resistance equal to that specified in Figure 5.5-3. No insulation is required for climates with less than 3,000 HDD65 or for those portions of walls more than one story below grade.

5.4.3 Procedure for Using the Alternate Component Packages (ACP).

5.4.3.1 The prescriptive envelope criteria for each of 30 climate ranges are contained in Tables 5.4-2 through 5.4-31.

5.4.3.2 The following steps shall be used to determine compliance with these prescriptive envelope criteria.

5.4.3.2.1 Determine appropriate climate range using either (a) or (b) below.

(a) From Table 5.4-1, select the appropriate ACP Table based on the climate for the building site. The main climate variables that are needed for the proper selection of an ACP Table are cooling degree-days base 65 °F (CDD65), heating degree-days base 50 °F (HDD50), and annual average daily incident of solar radiation on the east or west vertical surface of the facade, Btu/ft^2/day (VSEW). For certain climate ranges this must be augmented by cooling degree-hours base 80 °F (CDH80).

(1) This data, for a specific building location, may be acquired from the U.S. Weather Service of the National Oceanic and Atmospheric Administration or the local weather bureau. The column designated "ACP Table No." in Table 5.4-1 contains the table number of the appropriate ACP Table.

Table 5.4-1
Climate Data Grouped by ACP Tables

ACP Table Number	HDD50 Range	CDD65 Range	VSEW Range	CDH80 Range	Example Cities
5.4-2	0	3001-4500	>800		Barbers Point, Hilo, Honolulu, Lihue
5.4-3	0	>4500	>845		Guantanamo Bay, Kwajalein, San Juan, Wake Island
5.4-4	1-1000	0-1150	560-845		Arcata, North Bend
5.4-5	1-1000	0- 300	>845		Oakland, San Francisco, Santa Maria, Sunnyvile
5.4-6	1-1000	301-1150	>845		El Toro, Long Beach, Los Angeles, San Diego
5.4-7	1-1000	1151-2000	560-845		Atlanta, Augusta, Birmingham, Cherry Point, Greenville
5.4-8	1-1000	1151-2000	>845		Fresno, Red Bluff, Sacramento
5.4-9	1-1000	2001-3250	560-845		Charleston, Houston, Jackson, Montgomery, New Orleans
5.4-10	1-1000	2001-3250	>845	0-18000	Austin, Bakersfield, El Paso, Fort Worth, Tallahassee, Tampa
5.4-11	1-1000	2001-3250	>845	>18000	China Lake, Las Vegas, Tucson
5.4-12	1-1000	3251-4500	>845	0-18000	Brownsville, Corpus Christi, Miami, Orlando, West Palm Beach
5.4-13	1-1000	3251-4500	>845	>18000	Loredo, Phoenix, Yuma
5.4-14	1001-1750	0- 500	560-845		Olympia, Portland, Salem, Seattle/Tacoma, Whidbey Island
5.4-15	1001-1750	501-1150	560-845		Asheville, Medford
5.4-16	1001-1750	1-1150	>845		Prescott, Winslow, Yucca
5.4-17	1001-1750	1151-2000	560-845		Charlotte, Chattanooga, Knoxville, Norfolk, Raleigh, Richmond
5.4-18	1001-1750	1151-2000	>845		Albuquerque, Lubbock, Oklahoma City, Roswell, Tucumcari
5.4-19	1001-1750	2001-3250	560-845		Fort Smith, Memphis, Tulsa
5.4-20	1751-2600	0-1150	560-845		Baltimore, Boston, Columbus, Harrisburg, New York, Washington
5.4-21	2601-3200	0-1150	560-845		Akron, Chicago, Detroit, Hartford, Indianapolis, Pittsburgh
5.4-22	1751-3200	0-1150	>845		Boise, Colorado Springs, Denver, Reno, Salt Lake City
5.4-23	1751-3200	1151-2000	560-845		Evansville, Lexington, Louisville, Saint Louis, Springfield
5.4-24	1751-3200	1151-2000	>845		Dodge City, Grand Junction
5.4-25	3201-4000	0-1150	560-845		Albany, Buffalo, Concord, Des Moines, Milwaukee, Rapid City
5.4-26	4001-5000	0-1150	560-845		Bangor, Cutbank, Huron, Minneapolis, Rochester, Sioux Falls
5.4-27	3201-4000	0-1150	>845		Casper, Cheyenne, Ely, North Platte, Scottsbluff
5.4-28	4001-5000	0-1150	>845		Bryce, Eagle, Rock Springs
5.4-29	5001-6500	0-1150	560-845		Bismarck, Duluth, Fargo, Glasgow, International Falls
5.4-30	1-6500	< 100	<560		Adak, Anchorage, Juneau, Kodiak, Yakutat
5.4-31	>6500	< 100	<560		Bethel, Fairbanks, King Salmon, Nome, Summit

ALTERNATE COMPONENT PACKAGES FOR:

HDD65 = 0
CDD65 = 3001 - 4500
VSEW = > 800

Barbers Point HI
Hilo HI
Honolulu HI
Lihue HI

TABLE 6.4

INTERNAL LOAD DENSITY (ILD) RANGE	PROJECTION FACTOR (PF)	SHADING COEFF RANGE (SCx)	BASE CASE Uof 1.15 to 0.82	BASE CASE Uof 0.81 to 0	BASE CASE Uof N/A	PERIMETER DAYLIGHTING Uof 1.15 to 0.82	PERIMETER DAYLIGHTING Uof 0.81 to 0	PERIMETER DAYLIGHTING Uof 0.81 to 0 VLT ≥ SC
0 - 1.50	0.000 - 0.249	1.000 - 0.71	17	18		19	19	20
		0.709 - 0.60	21	20		24	24	24
		0.599 - 0.50	25	24		29	28	29
		0.499 - 0.38	31	30		38	34	35
		0.379 - 0.25	41	40		48	48	47
		0.249 - 0.00	67	62		77	72	74
	0.250 - 0.499	1.000 - 0.71	22	21		26	25	26
		0.709 - 0.60	28	27		32	31	32
		0.599 - 0.50	33	32		39	37	39
		0.499 - 0.38	41	39		48	45	47
		0.379 - 0.00	56	52		65	61	63
	0.500 -	1.000 - 0.71	29	28		34	32	33
		0.709 - 0.60	36	35		42	41	42
		0.599 - 0.50	44	42		51	49	50
		0.499 - 0.00	54	51		63	59	61
1.51 - 3.00	0.000 - 0.249	1.000 - 0.71	14	13		22	21	23
		0.709 - 0.60	17	17		28	27	29
		0.599 - 0.50	21	20		33	32	34
		0.499 - 0.38	26	24		41	39	41
		0.379 - 0.25	34	33		56	52	55
		0.249 - 0.00	58	62		86	77	84
	0.250 - 0.499	1.000 - 0.71	18	18		29	28	30
		0.709 - 0.60	23	22		37	35	38
		0.599 - 0.50	28	27		45	42	45
		0.499 - 0.38	34	32		55	51	54
		0.379 ~ 0.00	46	43		73	68	72
	0.500 -	1.000 - 0.71	24	23		30	30	39
		0.709 - 0.60	30	29		40	40	40
		0.599 - 0.50	36	34		50	55	50
		0.499 - 0.00	45	42		71	[illegible]	70

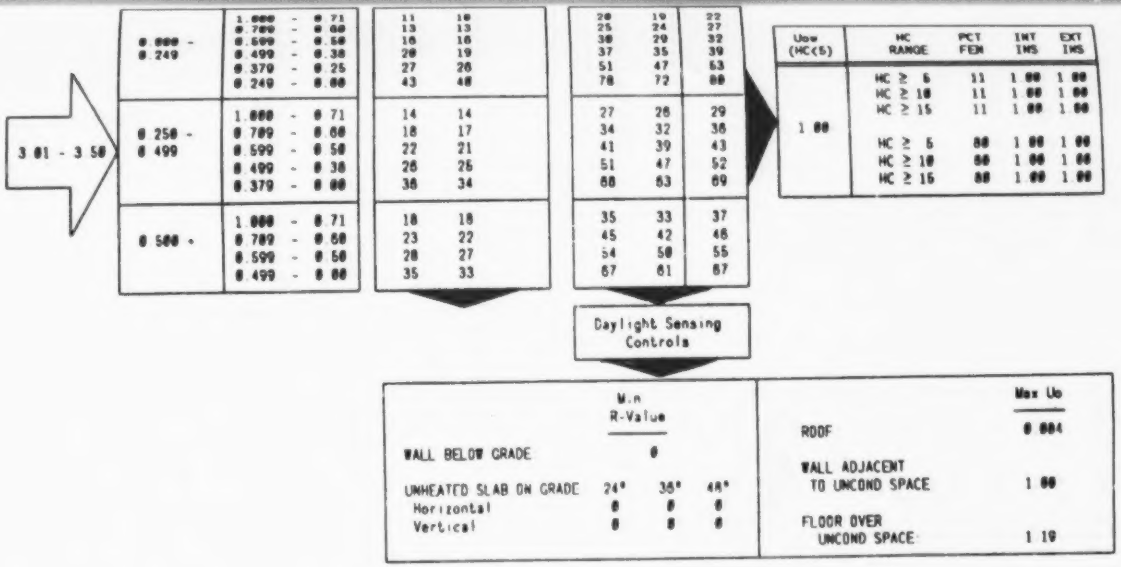
OPAQUE WALL Uow

ILD 0 - 1.50:

LIGHT WEIGHT WALL Uow (HC<5)	MASS WALL HC RANGE	PCT FEN	INT INS	EXT INS
1.00	HC ≥ 5	17	1.00	1.00
	HC ≥ 10	17	1.00	1.00
	HC ≥ 15	17	1.00	1.00
	HC ≥ 5	77	1.00	1.00
	HC ≥ 10	77	1.00	1.00
	HC ≥ 15	77	1.00	1.00

ILD 1.51 - 3.00:

LIGHT WEIGHT WALL Uow (HC<5)	MASS WALL HC RANGE	PCT FEN	INT INS	EXT INS
1.00	HC ≥ 5	14	1.00	1.00
	HC ≥ 10	14	1.00	1.00
	HC ≥ 15	14	1.00	1.00
	HC ≥ 5	86	1.00	1.00
	HC ≥ 10	86	1.00	1.00
	HC ≥ 15	86	1.00	1.00



3.01 - 3.50

0.000 - 0.249	1.000 - 0.71	11	10	20	19	22
	0.709 - 0.60	13	13	25	24	27
	0.599 - 0.50	16	16	30	29	32
	0.499 - 0.38	20	19	37	35	39
	0.379 - 0.25	27	26	51	47	53
	0.249 - 0.00	43	40	78	72	80
0.250 - 0.499	1.000 - 0.71	14	14	27	26	29
	0.709 - 0.60	18	17	34	32	36
	0.599 - 0.50	22	21	41	39	43
	0.499 - 0.38	26	25	51	47	52
	0.379 - 0.00	36	34	68	63	69
0.500 +	1.000 - 0.71	18	18	35	33	37
	0.709 - 0.60	23	22	45	42	46
	0.599 - 0.50	28	27	54	50	55
	0.499 - 0.00	35	33	67	61	67

Uow (HC<5)	HC RANGE	PCT FEN	INT INS	EXT INS
1.00	HC ≥ 5	11	1.00	1.00
	HC ≥ 10	11	1.00	1.00
	HC ≥ 15	11	1.00	1.00
	HC ≥ 5	00	1.00	1.00
	HC ≥ 10	00	1.00	1.00
	HC ≥ 15	00	1.00	1.00

Daylight Sensing Controls

	Min R-Value		
WALL BELOW GRADE	0		
UNHEATED SLAB ON GRADE	24"	36"	48"
Horizontal	0	0	0
Vertical	0	0	0

	Max Uo
ROOF	0.084
WALL ADJACENT TO UNCOND SPACE	1.00
FLOOR OVER UNCOND SPACE	1.10

TABLE 1

ALTERNATE COMPONENT
PACKAGES FOR:

HDD65 = 0
CDD65 = > 4500
VSEW = > 845

Guantanamo Bay CU
Kwajalein Island
Koror Island
San Juan PR
Wake Island

INTERNAL LOAD DENSITY (ILD) RANGE	PROJECTION FACTOR (PF)	SHADING COEFF RANGE (SCx)	BASE CASE Uof 1.15 to 0.82	BASE CASE Uof 0.81 to 0	BASE CASE Uof N/A	PERIMETER DAYLIGHTING Uof 1.15 to 0.82	PERIMETER DAYLIGHTING Uof 0.81 to 0	PERIMETER DAYLIGHTING Uof 0.81 to 0 VLT ≥ SC
0 - 1.50	0.000 - 0.249	1.000 - 0.71	14	14		17	16	17
		0.709 - 0.60	19	18		21	21	22
		0.599 - 0.50	23	22		28	26	28
		0.499 - 0.38	29	28		33	32	33
		0.379 - 0.25	42	39		49	46	47
		0.249 - 0.00	61	72		96	82	85
	0.250 - 0.499	1.000 - 0.71	20	19		23	22	23
		0.709 - 0.60	26	25		30	29	30
		0.599 - 0.50	32	31		37	35	37
		0.499 - 0.38	41	39		48	45	46
		0.379 - 0.00	62	56		73	66	68
	0.500 +	1.000 - 0.71	27	26		31	30	31
		0.709 - 0.60	35	34		41	39	40
		0.599 - 0.50	45	42		53	49	50
		0.499 - 0.00	59	54		78	63	65
1.51 - 3.00	0.000 - 0.249	1.000 - 0.71	12	12		19	19	21
		0.709 - 0.60	16	15		25	24	28
		0.599 - 0.50	19	19		31	30	32
		0.499 - 0.38	24	23		40	38	40
		0.379 - 0.25	35	33		60	54	58
		0.249 - 0.00	60	60		100	93	100
	0.250 - 0.499	1.000 - 0.71	18	18		27	26	28
		0.709 - 0.60	22	21		36	34	36
		0.599 - 0.50	27	26		45	42	45
		0.499 - 0.38	34	32		59	53	57
		0.379 - 0.00	51	47		87	77	82
	0.500 +	1.000 - 0.71	22	22		37	35	38
		0.709 - 0.60	29	28		50	48	49
		0.599 - 0.50	37	35		65	60	61
		[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]

OPAQUE WALL Uow

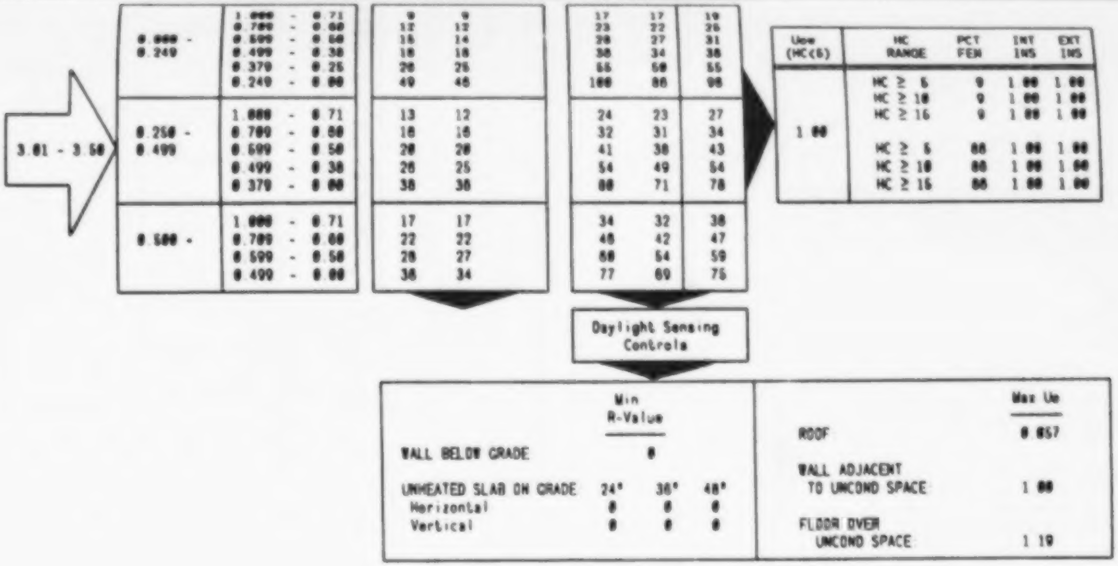
LIGHT WEIGHT WALL | MASS WALL

ILD 0 - 1.50:

Uow (HC<5)	HC RANGE	PCT FEN	INT INS	EXT INS
1.00	HC ≥ 5	14	1.00	1.00
	HC ≥ 10	14	1.00	1.00
	HC ≥ 15	14	1.00	1.00
	HC ≥ 5	85	1.00	1.00
	HC ≥ 10	85	1.00	1.00
	HC ≥ 15	85	1.00	1.00

ILD 1.51 - 3.00:

Uow (HC<5)	HC RANGE	PCT FEN	INT INS	EXT INS
1.00	HC ≥ 5	12	1.00	1.00
	HC ≥ 10	12	1.00	1.00
	HC ≥ 15	12	1.00	1.00
	HC ≥ 5	93	1.00	1.00
	HC ≥ 10	93	1.00	1.00
	HC ≥ 15	93	1.00	1.00



3.01 - 3.50

0.000 - 0.249	1.000 - 0.71	9	9	17	17	19
	0.700 - 0.60	12	12	23	22	26
	0.600 - 0.50	15	14	28	27	31
	0.499 - 0.38	18	18	38	34	38
	0.370 - 0.25	20	25	66	50	55
	0.240 - 0.00	40	46	100	86	98
0.250 - 0.499	1.000 - 0.71	13	12	24	23	27
	0.700 - 0.60	18	16	32	31	34
	0.600 - 0.50	20	20	41	38	43
	0.499 - 0.38	26	25	54	49	54
	0.370 - 0.00	38	30	80	71	78
0.500 -	1.000 - 0.71	17	17	34	32	38
	0.700 - 0.60	22	22	46	42	47
	0.599 - 0.50	28	27	60	54	59
	0.499 - 0.00	38	34	77	69	75

Uow (HC<6)	HC RANGE	PCT FEN	INT INS	EXT INS
1.00	HC ≥ 6	0	1.00	1.00
	HC ≥ 10	0	1.00	1.00
	HC ≥ 15	0	1.00	1.00
	HC ≥ 6	80	1.00	1.00
	HC ≥ 10	80	1.00	1.00
	HC ≥ 15	80	1.00	1.00

Daylight Sensing Controls

	Min R-Value		
WALL BELOW GRADE	0		
UNHEATED SLAB ON GRADE	24"	36"	48"
Horizontal	0	0	0
Vertical	0	0	0

	Max Uo
ROOF	0.057
WALL ADJACENT TO UNCOND SPACE	1.00
FLOOR OVER UNCOND SPACE	1.10

ALTERNATE COMPONENT
PACKAGES FOR:

Arcata CA
North Bend OR

TABLE 14

HDD50 = 1 - 1000
CDD65 = 0 - 1150
VSEW = 560 - 845

INTERNAL LOAD DENSITY (ILD) RANGE	PROJECTION FACTOR (PF)	SHADING COEFF RANGE (SCx)	BASE CASE Uof 0.81 to 0.46	BASE CASE Uof 0.45 to 0.39	BASE CASE Uof 0.38 to 0	PERIMETER DAYLIGHTING N/A	PERIMETER DAYLIGHTING VLT ≥ SC
0 - 1.50	0.000 - 0.249	1.000 - 0.71	24	32	33		
		0.709 - 0.60	26	37	39		
		0.599 - 0.50	28	41	45		
		0.499 - 0.38	29	48	51		
		0.379 - 0.25	30	52	59		
		0.249 - 0.00	31	59	70		
	0.250 - 0.499	1.000 - 0.71	27	39	42		
		0.709 - 0.60	29	45	49		
		0.599 - 0.50	30	49	55		
		0.499 - 0.38	30	53	61		
		0.379 - 0.00	31	58	68		
	0.500 +	1.000 - 0.71	30	47	52		
		0.709 - 0.60	31	53	59		
		0.599 - 0.50	31	56	64		
		0.499 - 0.00	31	59	69		
1.51 - 3.00	0.000 - 0.249	1.000 - 0.71	22	27	28		
		0.709 - 0.60	25	33	34		
		0.599 - 0.50	27	37	39		
		0.499 - 0.38	30	42	46		
		0.379 - 0.25	32	50	55		
		0.249 - 0.00	35	60	69		
	0.250 - 0.499	1.000 - 0.71	27	35	38		
		0.709 - 0.60	29	41	43		
		0.599 - 0.50	31	46	49		
		0.499 - 0.38	33	51	56		
		0.379 - 0.00	35	56	65		
	0.500 +	1.000 - 0.71	30	43	45		
		0.709 - 0.60	32	49	53		
		[illegible]	[illegible]	[illegible]	[illegible]		
		[illegible]	[illegible]	[illegible]	[illegible]		

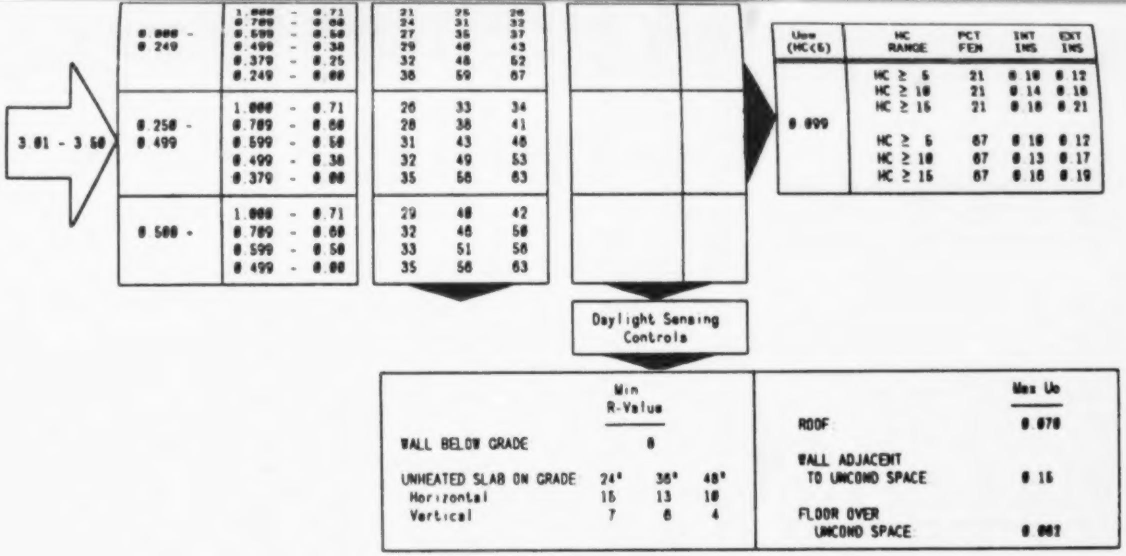
OPAQUE WALL Uow: LIGHT WEIGHT WALL | MASS WALL

ILD 0 - 1.50:

Uow (HC<5)	HC RANGE	PCT FEN	INT INS	EXT INS
0.099	HC ≥ 5	24	0.10	0.11
	HC ≥ 10	24	0.12	0.13
	HC ≥ 15	24	0.13	0.14
	HC ≥ 5	70	0.10	0.11
	HC ≥ 10	70	0.11	0.13
	HC ≥ 15	70	0.13	0.14

ILD 1.51 - 3.00:

Uow (HC<5)	HC RANGE	PCT FEN	INT INS	EXT INS
0.099	HC ≥ 5	22	0.10	0.12
	HC ≥ 10	22	0.13	0.16
	HC ≥ 15	22	0.16	0.19
	HC ≥ 5	69	0.10	0.12
	HC ≥ 10	69	0.12	0.16
	HC ≥ 15	69	0.16	0.18



3.01 - 3.50

0.000 - 0.249	1.000 - 0.71	21	25	26
	0.709 - 0.60	24	31	32
	0.599 - 0.50	27	35	37
	0.499 - 0.38	29	40	43
	0.379 - 0.25	32	48	52
	0.249 - 0.00	38	59	67
0.250 - 0.499	1.000 - 0.71	26	33	34
	0.709 - 0.60	28	38	41
	0.599 - 0.50	31	43	46
	0.499 - 0.38	32	49	53
	0.379 - 0.00	35	58	63
0.500 -	1.000 - 0.71	29	40	42
	0.709 - 0.60	32	46	50
	0.599 - 0.50	33	51	56
	0.499 - 0.00	35	56	63

Uow (HC<5)	HC RANGE	PCT FEN	INT INS	EXT INS
0.099	HC ≥ 5	21	0.10	0.12
	HC ≥ 10	21	0.14	0.16
	HC ≥ 15	21	0.16	0.21
	HC ≥ 5	67	0.10	0.12
	HC ≥ 10	67	0.13	0.17
	HC ≥ 15	67	0.16	0.19

Daylight Sensing Controls

	Min R-Value		
WALL BELOW GRADE	0		
UNHEATED SLAB ON GRADE	24"	36"	48"
Horizontal	15	13	10
Vertical	7	6	4

	Max Uo
ROOF	0.070
WALL ADJACENT TO UNCOND SPACE	0.15
FLOOR OVER UNCOND SPACE	0.082

TABLE 1

ALTERNATE COMPONENT
PACKAGES FOR:

HDD60 = 1 - 1000
CDD65 = 0 - 300
VSEF = > 845

Oakland CA
Point Mugu CA
San Francisco CA
Santa Maria CA
Sunnyville CA

Uef

INTERNAL LOAD DENSITY (ILD) RANGE	PROJECTION FACTOR (PF)	SHADING COEFF RANGE (SCx)	BASE CASE 1.15 to 0.82	BASE CASE 0.81 to 0	BASE CASE N/A	PERIMETER DAYLIGHTING 1.15 to 0.82	PERIMETER DAYLIGHTING 0.81 to 0	PERIMETER DAYLIGHTING 0.45 to 0 VLT ≥ SC
0 - 1.50	0.000 - 0.249	1.000 - 0.71	24	20		28	28	29
		0.709 - 0.60	29	31		32	34	38
		0.599 - 0.50	34	36		36	39	43
		0.499 - 0.38	39	43		41	46	51
		0.379 - 0.25	47	54		49	57	66
		0.249 - 0.00	60	72		61	75	90
	0.250 - 0.499	1.000 - 0.71	31	33		33	36	39
		0.709 - 0.60	37	40		39	43	48
		0.599 - 0.50	42	46		44	50	56
		0.499 - 0.38	47	54		50	57	67
		0.379 - 0.00	60	68		58	69	85
	0.500 -	1.000 - 0.71	38	42		41	46	50
		0.709 - 0.60	45	50		47	54	61
		0.599 - 0.50	50	57		52	61	71
		0.499 - 0.00	56	65		57	69	84
1.51 - 3.00	0.000 - 0.249	1.000 - 0.71	19	20		26	27	28
		0.709 - 0.60	24	25		31	33	36
		0.599 - 0.50	28	29		35	38	41
		0.499 - 0.38	32	34		40	45	49
		0.379 - 0.25	40	44		49	56	64
		0.249 - 0.00	54	62		61	74	93
	0.250 - 0.499	1.000 - 0.71	25	26		32	35	37
		0.709 - 0.60	31	32		38	42	48
		0.599 - 0.50	35	38		43	48	54
		0.499 - 0.38	41	44		49	56	65
		0.379 - 0.00	49	56		57	68	83
	0.500 -	1.000 - 0.71	32	33		40	44	48
		0.709 - 0.60	38	41		46	52	60

OPAQUE WALL Uow

LIGHT WEIGHT WALL	MASS WALL			
Uow (HC<5)	HC RANGE	PCT FEN	INT INS	EXT INS
0.15	HC ≥ 5	24	0.21	0.37
	HC ≥ 10	24	0.30	0.50
	HC ≥ 15	24	0.47	0.50
	HC ≥ 5	86	0.21	0.37
	HC ≥ 10	86	0.36	0.49
	HC ≥ 15	86	0.46	0.50

Uow (HC<5)	HC RANGE	PCT FEN	INT INS	EXT INS
0.15	HC ≥ 5	19	0.20	0.49
	HC ≥ 10	19	0.40	0.72
	HC ≥ 15	19	0.67	0.80
	HC ≥ 5	93	0.20	0.30
	HC ≥ 10	93	0.30	0.53
	HC ≥ 15	93	0.40	0.61

3.01 - 3.50

0.000 - 0.249	1.000 - 0.71	17	17	25	28	27
	0.709 - 0.60	21	21	30	32	34
	0.599 - 0.50	24	26	34	37	40
	0.499 - 0.38	29	30	39	43	48
	0.379 - 0.25	36	39	47	54	63
	0.249 - 0.00	49	56	60	72	90
0.250 - 0.499	1.000 - 0.71	22	23	31	34	38
	0.709 - 0.60	27	28	37	41	45
	0.599 - 0.50	31	33	42	47	53
	0.499 - 0.38	36	39	47	53	63
	0.379 - 0.00	45	50	58	68	81
0.500 +	1.000 - 0.71	28	29	38	42	47
	0.709 - 0.60	34	36	45	50	58
	0.599 - 0.50	38	42	50	57	68
	0.499 - 0.00	44	49	55	65	79

Daylight Sensing Controls

Uow (HC<5)	HC RANGE	PCT FEN	INT INS	EXT INS
0.16	HC ≥ 5	17	0.32	0.53
	HC ≥ 10	17	0.53	0.80
	HC ≥ 15	17	0.74	0.88
	HC ≥ 5	90	0.22	0.39
	HC ≥ 10	90	0.39	0.58
	HC ≥ 15	90	0.52	0.85

	Min R-Value		
WALL BELOW GRADE	7		
UNHEATED SLAB ON GRADE:	24"	36"	48"
Horizontal	11	9	7
Vertical	6	5	4

	Max Uo
ROOF:	0.089
WALL ADJACENT TO UNCOND SPACE:	0.21
FLOOR OVER UNCOND SPACE:	0.094

TABLE 1

ALTERNATE COMPONENT
PACKAGES FOR:

HDD65 = 1 - 1000
CDD65 = 301 - 1150
VSEW = > 845

El Toro CA
Long Beach CA
Los Angeles CA
San Diego CA

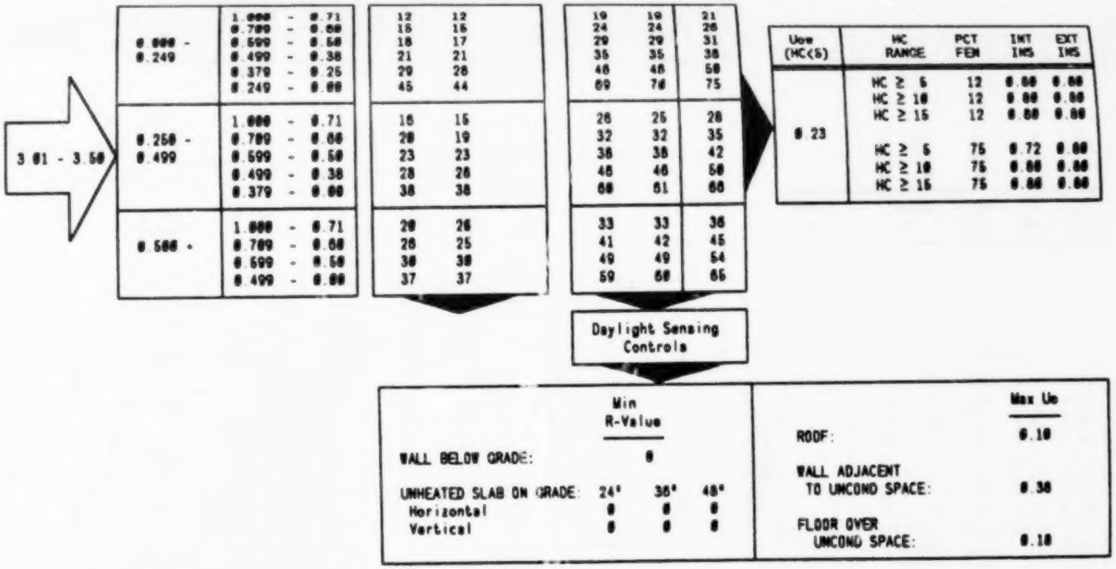
INTERNAL LOAD DENSITY (ILD) RANGE	PROJECTION FACTOR (PF)	SHADING COEFF RANGE (SCx)	BASE CASE Uof 1.15 to 0.82	BASE CASE Uof 0.81 to 0	BASE CASE Uof N/A	PERIMETER DAYLIGHTING Uof 1.15 to 0.82	PERIMETER DAYLIGHTING Uof 0.81 to 0	PERIMETER DAYLIGHTING Uof 0.81 to 0 (VLT ≥ SC)
0 - 1.50	0.000 - 0.249	1.000 - 0.71	18	18		21	21	21
		0.700 - 0.60	23	23		26	26	26
		0.599 - 0.50	27	27		30	31	31
		0.499 - 0.38	33	33		36	37	38
		0.379 - 0.25	43	44		47	49	50
		0.249 - 0.00	64	67		70	73	75
	0.250 - 0.499	1.000 - 0.71	24	24		27	27	28
		0.700 - 0.60	30	30		34	34	35
		0.599 - 0.50	36	36		40	40	41
		0.499 - 0.38	43	43		47	49	50
		0.379 - 0.00	56	57		61	64	65
	0.500 -	1.000 - 0.71	31	32		35	35	36
		0.700 - 0.60	39	39		43	44	45
		0.599 - 0.50	46	47		51	52	53
		0.499 - 0.00	55	56		60	62	64
1.51 - 3.00	0.000 - 0.249	1.000 - 0.71	14	14		21	21	22
		0.700 - 0.60	18	18		26	26	27
		0.599 - 0.50	21	21		31	31	33
		0.499 - 0.38	26	26		37	37	39
		0.379 - 0.25	35	34		49	49	52
		0.249 - 0.00	54	54		72	74	78
	0.250 - 0.499	1.000 - 0.71	19	19		27	27	29
		0.700 - 0.60	24	24		34	34	36
		0.599 - 0.50	28	28		41	41	43
		0.499 - 0.38	34	34		49	49	52
		0.379 - 0.00	46	46		64	65	69
	0.500 -	1.000 - 0.71	25	25		38	38	38
		0.700 - 0.60	31	31		44	44	47
		0.599 - 0.50	37	37		52	53	60
		0.499 - 0.00	[illegible]	[illegible]		[illegible]	64	67

OPAQUE WALL Uow (ILD 0 - 1.50)

LIGHT WEIGHT WALL Uow (HC<6)	MASS WALL HC RANGE	MASS WALL PCT FEN	MASS WALL INT INS	MASS WALL EXT INS
0.23	HC ≥ 5	10	0.50	0.00
	HC ≥ 10	10	0.00	0.00
	HC ≥ 15	10	0.00	0.00
	HC ≥ 5	75	0.40	0.00
	HC ≥ 10	75	0.00	0.00
	HC ≥ 15	75	0.00	0.00

OPAQUE WALL Uow (ILD 1.51 - 3.00)

LIGHT WEIGHT WALL Uow (HC<6)	MASS WALL HC RANGE	MASS WALL PCT FEN	MASS WALL INT INS	MASS WALL EXT INS
0.23	HC ≥ 5	14	0.00	0.00
	HC ≥ 10	14	0.00	0.00
	HC ≥ 15	14	0.00	0.00
	HC ≥ 5	78	0.65	0.00
	HC ≥ 10	78	0.34	0.00
	HC ≥ 15	78	0.00	0.00



3.01 - 3.50

0.000 - 0.249	1.000 - 0.71	12	12	19	19	21
	0.709 - 0.60	15	16	24	24	26
	0.599 - 0.50	18	17	29	29	31
	0.499 - 0.38	21	21	35	35	38
	0.379 - 0.25	29	28	40	40	50
	0.249 - 0.00	45	44	69	70	75
0.250 - 0.499	1.000 - 0.71	16	15	26	25	28
	0.709 - 0.60	20	19	32	32	35
	0.599 - 0.50	23	23	38	38	42
	0.499 - 0.38	28	26	46	46	50
	0.379 - 0.00	30	30	60	61	60
0.500 +	1.000 - 0.71	20	26	33	33	36
	0.709 - 0.60	26	25	41	42	45
	0.599 - 0.50	30	30	49	49	54
	0.499 - 0.00	37	37	59	60	65

Uow (HC<5)	HC RANGE	PCT FEN	INT INS	EXT INS
0.23	HC ≥ 5	12	0.00	0.00
	HC ≥ 10	12	0.00	0.00
	HC ≥ 15	12	0.00	0.00
	HC ≥ 5	75	0.72	0.00
	HC ≥ 10	75	0.00	0.00
	HC ≥ 15	75	0.00	0.00

Daylight Sensing Controls

	Min R-Value		
WALL BELOW GRADE:	0		
UNHEATED SLAB ON GRADE:	24"	36"	48"
Horizontal	0	0	0
Vertical	0	0	0

	Max Uo
ROOF:	0.10
WALL ADJACENT TO UNCOND SPACE:	0.30
FLOOR OVER UNCOND SPACE:	0.10

ALTERNATE COMPONENT
PACKAGES FOR:

HDD50 = 1 - 1000
CDD65 = 1151 - 2000
VSEW = 500 - 845

Atlanta GA
Birmingham AL
Cape Hatteras NC
Cherry Point NC
Greenville SC

INTERNAL LOAD DENSITY (ILD) RANGE	PROJECTION FACTOR (PF)	SHADING COEFF RANGE (SCx)	Uof: BASE CASE 1.15 to 0.82	BASE CASE 0.81 to 0	BASE CASE N/A	PERIMETER DAYLIGHTING 1.15 to 0.82	PERIMETER DAYLIGHTING 0.81 to 0	PERIMETER DAYLIGHTING 0.81 to 0, VLT ≥ SC
0 - 1.50	0.000 - 0.249	1.000 - 0.71	19	20		21	22	23
		0.709 - 0.60	24	25		26	27	28
		0.599 - 0.50	28	29		30	32	33
		0.499 - 0.38	32	35		35	38	39
		0.379 - 0.25	41	46		44	49	50
		0.249 - 0.00	58	64		59	69	70
	0.250 - 0.499	1.000 - 0.71	25	26		28	29	30
		0.709 - 0.60	30	32		33	36	36
		0.599 - 0.50	35	38		38	42	42
		0.499 - 0.38	41	45		44	49	50
		0.379 - 0.00	50	57		54	61	63
	0.500 +	1.000 - 0.71	31	33		34	37	38
		0.709 - 0.60	38	41		41	45	46
		0.599 - 0.50	43	47		47	52	53
		0.499 - 0.00	49	58		53	60	62
1.51 - 3.00	0.000 - 0.249	1.000 - 0.71	15	15		21	21	23
		0.709 - 0.60	19	19		26	27	28
		0.599 - 0.50	22	22		30	31	33
		0.499 - 0.38	26	27		35	37	39
		0.379 - 0.25	33	35		43	48	51
		0.249 - 0.00	47	52		59	68	71
	0.250 - 0.499	1.000 - 0.71	20	20		27	28	30
		0.709 - 0.60	24	26		33	35	37
		0.599 - 0.50	28	29		38	40	43
		0.499 - 0.38	33	35		43	49	50
		0.379 - 0.00	42	46		53	61	64
	0.500 +	1.000 - 0.71	26	28		34	36	38
		0.709 - 0.60	30	32		40	44	46
		0.599 - 0.50	35	37		48	51	54
		0.499 - 0.00	41	44		52	59	63

OPAQUE WALL Uow

LIGHT WEIGHT WALL / MASS WALL

ILD 0 - 1.50:

Uow (HC<5)	HC RANGE	PCT FEN	INT INS	EXT INS
0.18	HC ≥ 5	19	0.21	0.30
	HC ≥ 10	19	0.31	0.39
	HC ≥ 15	19	0.40	0.42
	HC ≥ 5	70	0.20	0.27
	HC ≥ 10	70	0.27	0.30
	HC ≥ 15	70	0.36	0.39

ILD 1.51 - 3.00:

Uow (HC<5)	HC RANGE	PCT FEN	INT INS	EXT INS
0.18	HC ≥ 5	16	0.22	0.34
	HC ≥ 10	16	0.30	0.43
	HC ≥ 15	16	0.45	0.47
	HC ≥ 5	71	0.20	0.20
	HC ≥ 10	71	0.29	0.30
	HC ≥ 15	71	0.39	0.40

3.01 - 3.50	0.000 - 0.249	1.000 - 0.71	13	13	20	20	22
		0.709 - 0.60	16	16	24	25	27
		0.599 - 0.50	18	19	28	29	32
		0.499 - 0.38	22	23	33	35	38
		0.379 - 0.25	28	30	41	46	49
		0.249 - 0.00	41	45	55	64	60
	0.250 - 0.499	1.000 - 0.71	16	17	25	27	29
		0.709 - 0.60	20	21	31	33	36
		0.599 - 0.50	24	25	35	38	41
		0.499 - 0.38	28	30	41	45	49
		0.379 - 0.00	36	39	50	57	62
	0.500 -	1.000 - 0.71	21	22	32	34	36
		0.709 - 0.60	26	27	38	41	45
		0.599 - 0.50	30	32	43	48	62
		0.499 - 0.00	35	38	49	56	81

Daylight Sensing Controls

Uow (HC<5)	HC RANGE	PCT FEN	INT INS	EXT INS
0.10	HC ≥ 5	13	0.22	0.34
	HC ≥ 10	13	0.30	0.43
	HC ≥ 15	13	0.40	0.48
	HC ≥ 5	09	0.20	0.29
	HC ≥ 10	09	0.30	0.39
	HC ≥ 15	09	0.40	0.41

	Min R-Value		
WALL BELOW GRADE	7		
UNHEATED SLAB ON GRADE	24"	36"	48"
Horizontal	11	9	7
Vertical	6	5	4

	Max Uo
ROOF	0.069
WALL ADJACENT TO UNCOND SPACE	0.21
FLOOR OVER UNCOND SPACE	0.095

ALTERNATE COMPONENT PACKAGES FOR:

HDD50 = 1 - 1000
CDD65 = 1151 - 2000
VSEW = > 846

Fresno CA
Redbluff CA
Sacramento CA

TABLE 5.4

		Uof	BASE CASE			PERIMETER DAYLIGHTING		
INTERNAL LOAD DENSITY (ILD) RANGE	PROJECTION FACTOR (PF)	SHADING COEFF RANGE (SCx)	1.15 to 0.82	0.81 to 0	N/A	1.15 to 0.82	0.81 to 0	0.81 to 0 VLT ≥ SC
0 - 1.50	0.000 - 0.249	1.000 - 0.71	19	20		21	22	22
		0.709 - 0.60	24	26		26	27	28
		0.599 - 0.50	28	29		30	32	33
		0.499 - 0.38	33	36		35	38	39
		0.379 - 0.25	41	45		44	49	50
		0.249 - 0.00	50	65		59	69	70
	0.250 - 0.499	1.000 - 0.71	25	28		27	29	29
		0.709 - 0.60	31	33		33	38	38
		0.599 - 0.50	35	38		38	42	42
		0.499 - 0.38	41	45		44	49	50
		0.379 - 0.00	61	58		53	62	63
	0.500 +	1.000 - 0.71	32	34		34	37	38
		0.709 - 0.60	38	42		41	45	46
		0.599 - 0.50	44	48		47	52	53
		0.499 - 0.00	50	67		53	61	62
1.51 - 3.00	0.000 - 0.249	1.000 - 0.71	15	15		20	21	22
		0.709 - 0.60	18	19		25	26	27
		0.599 - 0.50	22	23		29	30	32
		0.499 - 0.38	26	27		34	36	38
		0.379 - 0.25	33	35		42	47	49
		0.249 - 0.00	47	53		58	67	70
	0.250 - 0.499	1.000 - 0.71	20	20		26	28	29
		0.709 - 0.60	24	25		32	34	36
		0.599 - 0.50	28	30		37	40	42
		0.499 - 0.38	33	35		43	47	50
		0.379 - 0.00	42	46		62	60	63
	0.500 +	1.000 - 0.71	26	28		33	35	37
		0.709 - 0.60	31	32		40	43	45
		0.599 - 0.50	36	38		46	50	53
		0.499 - 0.00	41	46		52	59	62

OPAQUE WALL Uow

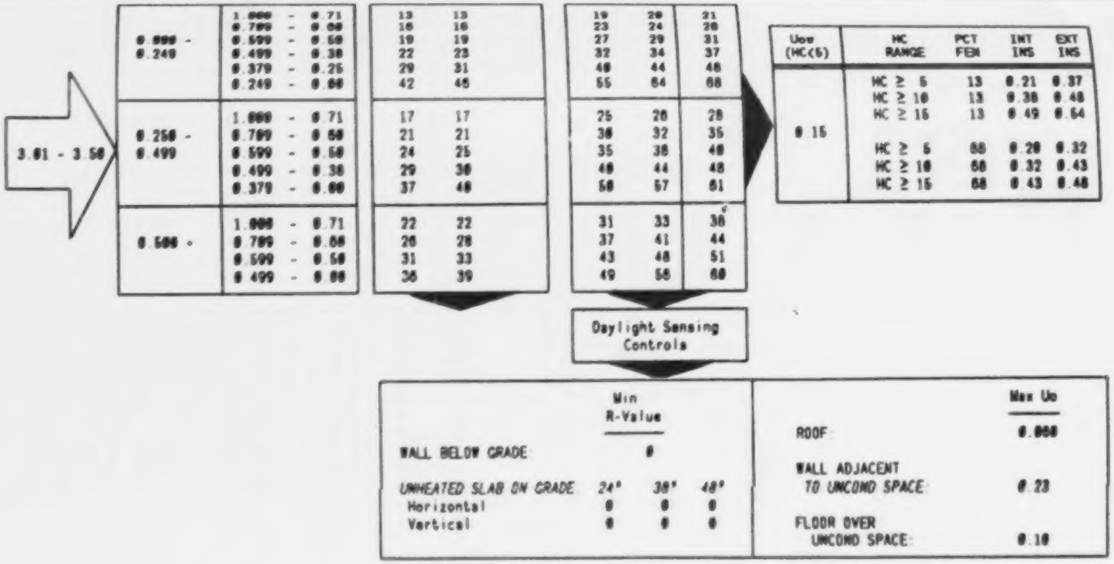
LIGHT WEIGHT WALL	MASS WALL

ILD 0 - 1.50:

Uow (HC<5)	HC RANGE	PCT FEN	INT INS	EXT INS
0.15	HC ≥ 5	19	0.20	0.33
	HC ≥ 10	19	0.34	0.44
	HC ≥ 15	19	0.44	0.49
	HC ≥ 5	70	0.19	0.38
	HC ≥ 10	70	0.29	0.40
	HC ≥ 15	70	0.40	0.44

ILD 1.51 - 3.00:

Uow (HC<5)	HC RANGE	PCT FEN	INT INS	EXT INS
0.15	HC ≥ 5	16	0.21	0.38
	HC ≥ 10	16	0.37	0.48
	HC ≥ 15	16	0.48	0.53
	HC ≥ 5	70	0.20	0.32
	HC ≥ 10	70	0.32	0.42
	HC ≥ 15	70	0.43	0.47



3.01 - 3.50

0.000 - 0.249	1.000 - 0.71	13	13	19	20	21
	0.709 - 0.60	16	16	23	24	28
	0.599 - 0.50	19	19	27	29	31
	0.499 - 0.38	22	23	32	34	37
	0.379 - 0.25	29	31	40	44	48
	0.249 - 0.00	42	45	55	64	68
0.250 - 0.499	1.000 - 0.71	17	17	25	26	28
	0.709 - 0.60	21	21	30	32	35
	0.599 - 0.50	24	25	35	38	40
	0.499 - 0.38	29	30	40	44	48
	0.379 - 0.00	37	40	50	57	61
0.500 -	1.000 - 0.71	22	22	31	33	36
	0.709 - 0.60	26	28	37	41	44
	0.599 - 0.50	31	33	43	48	51
	0.499 - 0.00	36	39	49	56	60

Daylight Sensing Controls

Uow (HC<6)	HC RANGE	PCT FEN	INT INS	EXT INS
0.15	HC ≥ 6	13	0.21	0.37
	HC ≥ 10	13	0.30	0.48
	HC ≥ 15	13	0.49	0.64
	HC ≥ 6	60	0.20	0.32
	HC ≥ 10	60	0.32	0.43
	HC ≥ 15	60	0.43	0.48

	Min R-Value		
WALL BELOW GRADE:	0		
UNHEATED SLAB ON GRADE:	*24"*	*36"*	*48"*
Horizontal	0	0	0
Vertical	0	0	0

	Max Uo
ROOF:	0.060
WALL ADJACENT *TO UNCOND SPACE:*	0.23
FLOOR OVER UNCOND SPACE:	0.10

ALTERNATE COMPONENT PACKAGES FOR:

HDD50 = 1 - 1000
CDD65 = 2000 - 3250
VSEW = 500 - 845

Baton Rouge LA
Charleston SC
Columbia SC
Houston TX
Jackson MS

Lake Charles LA
Little Rock AR
Macon GA
Meridian MS
Mobile AL

Montgomery AL
New Orleans LA
Port Angeles TX
Savannah GA
Shreveport LA

TABLE 1

INTERNAL LOAD DENSITY (ILD) RANGE	PROJECTION FACTOR (PF)	SHADING COEFF RANGE (SCx)	Uof: BASE CASE 1.15 to 0.82	BASE CASE 0.81 to 0	BASE CASE N/A	PERIMETER DAYLIGHTING 1.15 to 0.82	PERIMETER DAYLIGHTING 0.81 to 0	PERIMETER DAYLIGHTING 0.81 to 0 (VLT ≥ SC)
0 - 1.50	0.000 - 0.249	1.000 - 0.71	19	19		21	22	22
		0.700 - 0.60	23	24		26	27	27
		0.599 - 0.50	27	28		30	32	32
		0.499 - 0.38	32	34		36	38	38
		0.379 - 0.25	41	44		45	49	50
		0.249 - 0.00	59	66		63	72	73
	0.250 - 0.499	1.000 - 0.71	24	25		27	28	29
		0.700 - 0.60	30	31		33	35	36
		0.599 - 0.50	36	37		39	41	42
		0.499 - 0.38	41	44		45	49	50
		0.379 - 0.00	52	57		57	63	64
	0.500 +	1.000 - 0.71	31	32		34	36	37
		0.700 - 0.60	38	40		42	45	46
		0.599 - 0.50	44	47		48	52	53
		0.499 - 0.00	51	56		56	62	63
1.51 - 3.00	0.000 - 0.249	1.000 - 0.71	15	15		21	21	23
		0.700 - 0.60	18	18		26	27	28
		0.599 - 0.50	22	22		30	31	33
		0.499 - 0.38	26	27		36	38	40
		0.379 - 0.25	34	35		46	49	52
		0.249 - 0.00	49	53		65	72	76
	0.250 - 0.499	1.000 - 0.71	19	20		27	28	30
		0.700 - 0.60	24	24		33	36	37
		0.599 - 0.50	28	29		39	41	44
		0.499 - 0.38	33	36		46	49	52
		0.379 - 0.00	43	46		58	64	67
	0.500 +	1.000 - 0.71	26	26		35	36	38
		0.700 - 0.60	30	31		42	45	47
		0.599 - 0.50	35	37		49	53	56
		0.499 - 0.00	42	45		57	62	60

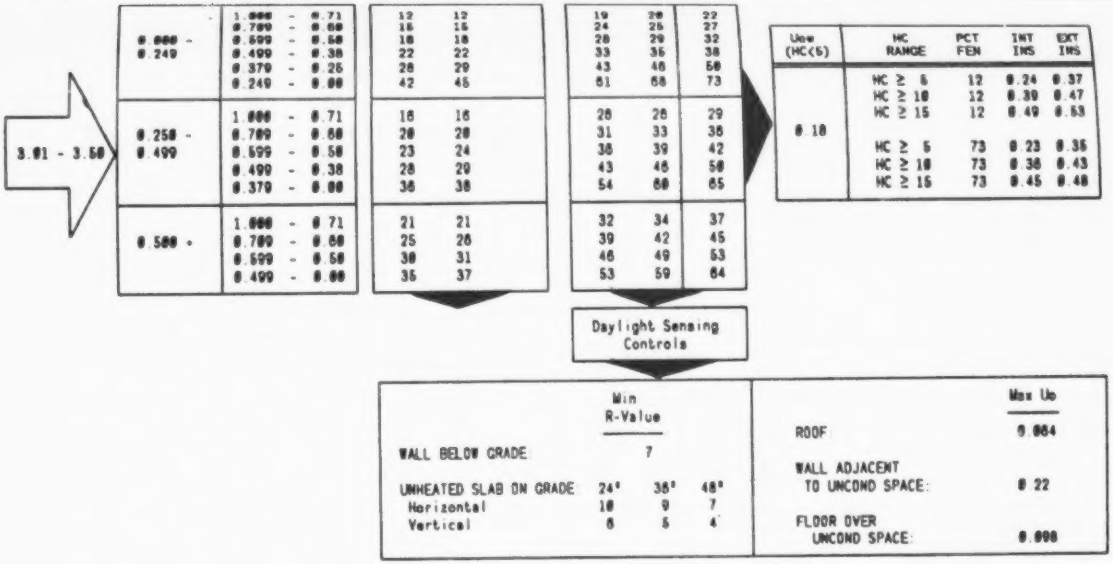
OPAQUE WALL Uow

ILD 0 - 1.50:

LIGHT WEIGHT WALL: Uow (HC<5)	MASS WALL: HC RANGE	PCT FEN	INT INS	EXT INS
0.10	HC ≥ 5	19	0.23	0.36
	HC ≥ 10	19	0.35	0.43
	HC ≥ 15	19	0.45	0.47
	HC ≥ 5	73	0.22	0.32
	HC ≥ 10	73	0.33	0.40
	HC ≥ 15	73	0.42	0.44

ILD 1.51 - 3.00:

LIGHT WEIGHT WALL: Uow (HC<5)	MASS WALL: HC RANGE	PCT FEN	INT INS	EXT INS
0.10	HC ≥ 5	16	0.24	0.37
	HC ≥ 10	16	0.30	0.47
	HC ≥ 15	16	0.40	0.52
	HC ≥ 5	70	0.24	0.30
	HC ≥ 10	70	0.36	0.44
	HC ≥ 15	70	0.46	0.48



0.000 - 0.249	1.000 - 0.71	12	12	19	20	22
	0.709 - 0.60	15	15	24	25	27
	0.599 - 0.50	18	18	28	29	32
	0.499 - 0.38	22	22	33	36	38
	0.379 - 0.25	28	29	43	46	50
	0.249 - 0.00	42	45	61	68	73
0.250 - 0.499	1.000 - 0.71	16	16	26	26	29
	0.709 - 0.60	20	20	31	33	36
	0.599 - 0.50	23	24	38	39	42
	0.499 - 0.38	28	29	43	46	50
	0.379 - 0.00	36	38	54	60	65
0.500 +	1.000 - 0.71	21	21	32	34	37
	0.709 - 0.60	25	26	39	42	45
	0.599 - 0.50	30	31	46	49	53
	0.499 - 0.00	36	37	53	59	64

Uow (HC<5)	HC RANGE	PCT FEN	INT INS	EXT INS
0.10	HC ≥ 5	12	0.24	0.37
	HC ≥ 10	12	0.39	0.47
	HC ≥ 15	12	0.49	0.53
	HC ≥ 5	73	0.23	0.36
	HC ≥ 10	73	0.38	0.43
	HC ≥ 15	73	0.45	0.48

Daylight Sensing Controls

	Min R-Value		
WALL BELOW GRADE:	7		
UNHEATED SLAB ON GRADE:	24"	36"	48"
Horizontal	10	9	7
Vertical	6	5	4

	Max Uo
ROOF:	0.064
WALL ADJACENT TO UNCOND SPACE:	0.22
FLOOR OVER UNCOND SPACE:	0.090

ALTERNATE COMPONENT PACKAGES FOR:

HDD50 = 1 - 1000
CDD65 = 2001 - 3250
VSEW = > 845

Abilene TX	Del Rio TX	Sherman TX	TABLE [illegible]
Apalachicola FL	El Paso TX	Tallahassee FL	
Austin TX	Fort Worth TX	Tampa FL	
Bakersfield CA	Jacksonville FL	Waco TX	
Daytona Beach FL	San Antonio TX	Wichita Falls TX	

Uof

INTERNAL LOAD DENSITY (ILD) RANGE	PROJECTION FACTOR (PF)	SHADING COEFF RANGE (SCx)	BASE CASE 1.15 to 0.82	BASE CASE 0.81 to 0	BASE CASE N/A	PERIMETER DAYLIGHTING 1.15 to 0.82	PERIMETER DAYLIGHTING 0.81 to 0	PERIMETER DAYLIGHTING 0.81 to 0, VLT ≥ SC
0 - 1.50	0.000 - 0.249	1.000 - 0.71	19	19		21	21	22
		0.709 - 0.60	23	24		25	27	27
		0.599 - 0.50	27	28		29	31	32
		0.499 - 0.38	32	34		34	37	38
		0.379 - 0.25	40	44		43	48	49
		0.249 - 0.00	55	64		59	69	70
	0.250 - 0.499	1.000 - 0.71	24	26		27	28	29
		0.709 - 0.60	30	32		32	35	35
		0.599 - 0.50	34	37		37	41	41
		0.499 - 0.38	40	44		43	48	49
		0.379 - 0.00	50	56		53	61	62
	0.500 +	1.000 - 0.71	31	33		34	36	37
		0.709 - 0.60	37	40		40	44	45
		0.599 - 0.50	42	47		46	51	52
		0.499 - 0.00	49	55		52	60	61
1.51 - 3.00	0.000 - 0.249	1.000 - 0.71	16	16		20	21	22
		0.709 - 0.60	18	19		25	28	27
		0.599 - 0.50	21	22		29	31	32
		0.499 - 0.38	26	27		34	37	39
		0.379 - 0.25	33	36		43	48	50
		0.249 - 0.00	47	53		59	68	72
	0.250 - 0.499	1.000 - 0.71	19	20		28	28	29
		0.709 - 0.60	24	25		32	34	36
		0.599 - 0.50	28	29		37	40	42
		0.499 - 0.38	33	35		43	48	50
		0.379 - 0.00	41	46		53	61	64
	0.500 +	1.000 - 0.71	24	26		33	35	37
		0.709 - 0.60	30	32		40	43	46
		0.599 - 0.50	35	37		46	51	53
		0.499 - 0.00	41	44		52	60	63

OPAQUE WALL Uow

LIGHT WEIGHT WALL | MASS WALL

ILD 0 - 1.50:

Uow (HC<6)	HC RANGE	PCT FEN	INT INS	EXT INS
0.16	HC ≥ 6	19	0.17	0.26
	HC ≥ 10	19	0.22	0.32
	HC ≥ 15	19	0.29	0.35
	HC ≥ 6	70	0.17	0.23
	HC ≥ 10	70	0.21	0.30
	HC ≥ 15	70	0.27	0.32

ILD 1.51 - 3.00:

Uow (HC<6)	HC RANGE	PCT FEN	INT INS	EXT INS
0.16	HC ≥ 6	16	0.17	0.26
	HC ≥ 10	16	0.23	0.36
	HC ≥ 15	16	0.32	0.38
	HC ≥ 6	72	0.17	0.24
	HC ≥ 10	72	0.22	0.32
	HC ≥ 15	72	0.29	0.35

3.01 - 3.50

0.000 - 0.249	1.000 - 0.71	12	13	19	20	21
	0.709 - 0.60	15	16	23	24	26
	0.599 - 0.50	18	19	27	29	31
	0.499 - 0.38	22	23	32	34	37
	0.379 - 0.25	28	30	40	45	48
	0.249 - 0.00	41	46	56	65	70
0.250 - 0.499	1.000 - 0.71	16	17	25	26	28
	0.709 - 0.60	20	21	30	32	35
	0.599 - 0.50	24	25	35	38	41
	0.499 - 0.38	28	30	40	45	48
	0.379 - 0.00	36	39	50	57	62
0.500 +	1.000 - 0.71	21	22	31	33	36
	0.709 - 0.60	26	27	37	41	44
	0.599 - 0.50	30	32	43	48	52
	0.499 - 0.00	35	38	49	56	61

Daylight Sensing Controls

Uow (HC<5)	HC RANGE	PCT FEN	INT INS	EXT INS
0.15	HC ≥ 5	12	0.17	0.28
	HC ≥ 10	12	0.23	0.35
	HC ≥ 15	12	0.32	0.38
	HC ≥ 5	70	0.17	0.24
	HC ≥ 10	70	0.22	0.32
	HC ≥ 15	70	0.29	0.36

	Min R-Value		
WALL BELOW GRADE:	7		
UNHEATED SLAB ON GRADE:	24"	36"	48"
Horizontal	10	9	7
Vertical	6	5	4

	Max Uo
ROOF:	0.057
WALL ADJACENT TO UNCOND SPACE:	0.22
FLOOR OVER UNCOND SPACE:	0.100

TABLE 1.4

ALTERNATE COMPONENT
PACKAGES FOR:

HDD65 = 1 - 1000
CDD65 = 2001 - 3250
VSEW = > 845
CDH80 = > 10000

China Lake CA
Daggett CA
Las Vegas CA
Tuscon AZ

INTERNAL LOAD DENSITY (ILD) RANGE	PROJECTION FACTOR (PF)	SHADING COEFF RANGE (SCx)	BASE CASE Uof 1.15 to 0.82	BASE CASE Uof 0.81 to 0	BASE CASE Uof N/A	PERIMETER DAYLIGHTING Uof 1.15 to 0.82	PERIMETER DAYLIGHTING Uof 0.81 to 0	PERIMETER DAYLIGHTING Uof 0.81 to 0, VLT ≥ SC
0 - 1.50	0.000 - 0.249	1.000 - 0.71	17	17		18	19	19
		0.709 - 0.60	21	22		23	23	24
		0.599 - 0.50	25	26		27	28	29
		0.499 - 0.38	30	31		32	34	36
		0.379 - 0.25	39	42		42	45	46
		0.249 - 0.00	59	65		63	70	71
	0.250 - 0.499	1.000 - 0.71	22	23		24	25	26
		0.709 - 0.60	28	29		30	31	32
		0.599 - 0.50	33	34		36	37	38
		0.499 - 0.38	39	42		42	46	48
		0.379 - 0.00	51	60		56	60	61
	0.500 -	1.000 - 0.71	29	30		31	33	33
		0.709 - 0.60	36	38		39	41	42
		0.599 - 0.50	42	45		45	49	50
		0.499 - 0.00	50	54		54	59	60
1.51 - 3.00	0.000 - 0.249	1.000 - 0.71	14	14		18	19	20
		0.709 - 0.60	17	17		23	23	25
		0.599 - 0.50	20	21		27	28	30
		0.499 - 0.38	25	26		33	34	36
		0.379 - 0.25	33	34		43	45	48
		0.249 - 0.00	50	54		65	71	76
	0.250 - 0.499	1.000 - 0.71	18	18		24	25	28
		0.709 - 0.60	23	23		30	31	33
		0.599 - 0.50	27	28		36	37	40
		0.499 - 0.38	33	34		43	46	48
		0.379 - 0.00	43	46		58	61	66
	0.500 -	1.000 - 0.71	24	24		32	33	35
		0.709 - 0.60	29	31		39	41	43
		0.599 - 0.50	36	37		46	49	52

OPAQUE WALL Uow

ILD 0 - 1.50:

LIGHT WEIGHT WALL Uow (HC<5)	MASS WALL HC RANGE	MASS WALL PCT FEN	MASS WALL INT INS	MASS WALL EXT INS
0.17	HC ≥ 5	17	0.19	0.24
	HC ≥ 10	17	0.24	0.31
	HC ≥ 15	17	0.29	0.33
	HC ≥ 5	71	0.19	0.24
	HC ≥ 10	71	0.24	0.31
	HC ≥ 15	71	0.29	0.33

ILD 1.51 - 3.00:

LIGHT WEIGHT WALL Uow (HC<5)	MASS WALL HC RANGE	MASS WALL PCT FEN	MASS WALL INT INS	MASS WALL EXT INS
0.17	HC ≥ 5	14	0.19	0.26
	HC ≥ 10	14	0.24	0.31
	HC ≥ 15	14	0.30	0.34
	HC ≥ 5	76	0.19	0.26
	HC ≥ 10	76	0.24	0.31
	HC ≥ 15	76	0.30	0.34

3.01 - 3.50

0.000 - 0.249	1.000 - 0.71 0.709 - 0.60 0.599 - 0.50 0.499 - 0.38 0.379 - 0.25 0.249 - 0.00	12 15 17 21 28 44	12 15 18 22 29 46	17 21 25 31 40 61	17 22 26 32 43 57	19 24 28 35 46 72
0.250 - 0.499	1.000 - 0.71 0.709 - 0.60 0.599 - 0.50 0.499 - 0.38 0.379 - 0.00	15 20 23 28 37	16 20 24 29 39	23 28 34 40 53	23 29 35 43 58	25 32 38 46 62
0.500 +	1.000 - 0.71 0.709 - 0.60 0.599 - 0.50 0.499 - 0.00	20 25 30 36	21 26 31 38	30 37 44 52	31 39 46 56	33 42 50 61

Daylight Sensing Controls

Uow (HC<6)	HC RANGE	PCT FEN	INT INS	EXT INS
0.17	HC ≥ 5	12	0.19	0.26
	HC ≥ 10	12	0.24	0.31
	HC ≥ 15	12	0.30	0.34
	HC ≥ 5	72	0.19	0.26
	HC ≥ 10	72	0.26	0.32
	HC ≥ 15	72	0.31	0.36

	Min R-Value		
WALL BELOW GRADE:	0		
UNHEATED SLAB ON GRADE:	24"	36"	48"
Horizontal	0	0	0
Vertical	0	0	0

	Max Uo
ROOF:	0.049
WALL ADJACENT TO UNCOND SPACE:	0.26
FLOOR OVER UNCOND SPACE:	0.12

ALTERNATE COMPONENT PACKAGES FOR:

Brownsville TX
Corpus Christi TX
Kingsville TX
Miami FL
Orlando FL

West Palm Beach FL

TABLE 6.4-

HDD60 = 1 - 1000
CDD65 = 3261 - 4500
VSER = > 841
CDH80 = 0 - 10000

INTERNAL LOAD DENSITY (ILD) RANGE	PROJECTION FACTOR (PF)	SHADING COEFF RANGE (SCx)	BASE CASE Uof 1.15 to 0.02	BASE CASE Uof 0.81 to 0	BASE CASE Uof N/A	PERIMETER DAYLIGHTING Uof 1.15 to 0.02	PERIMETER DAYLIGHTING Uof 0.81 to 0	PERIMETER DAYLIGHTING Uof 0.81 to 0, VLT ≥ SC
0 - 1.00	0.000 - 0.249	1.000 - 0.71	16	16		18	17	18
		0.709 - 0.60	20	19		22	22	23
		0.599 - 0.50	24	23		27	27	28
		0.499 - 0.38	29	29		34	33	34
		0.379 - 0.25	41	40		40	40	40
		0.249 - 0.00	74	70		80	80	83
	0.250 - 0.499	1.000 - 0.71	21	20		24	24	24
		0.709 - 0.60	27	26		31	30	31
		0.599 - 0.50	33	32		38	37	38
		0.499 - 0.38	41	40		40	40	47
		0.379 - 0.00	59	67		60	66	67
	0.500 -	1.000 - 0.71	28	27		32	31	32
		0.709 - 0.60	38	35		42	41	42
		0.599 - 0.50	44	43		52	50	61
		0.499 - 0.00	67	64		67	63	66
1.01 - 3.00	0.000 - 0.249	1.000 - 0.71	13	12		19	19	21
		0.709 - 0.60	18	16		25	24	28
		0.599 - 0.50	20	19		31	30	32
		0.499 - 0.38	24	24		38	37	40
		0.379 - 0.25	34	33		55	52	58
		0.249 - 0.00	61	58		97	88	95
	0.250 - 0.499	1.000 - 0.71	17	17		27	28	28
		0.709 - 0.60	22	22		35	34	38
		0.599 - 0.50	27	28		43	41	44
		0.499 - 0.38	34	33		55	52	55
		0.379 - 0.00	49	47		70	73	78
	0.500 -	1.000 - 0.71	23	22		30	35	37
		0.709 - 0.60	30	29		40	40	49
		0.599 - 0.50	37	36		60	57	60
		[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]

OPAQUE WALL Uow

LIGHT WEIGHT WALL | MASS WALL

ILD 0 - 1.00:

Uow (HC<5)	HC RANGE	PCT FEN	INT INS	EXT INS
0.40	HC ≥ 5	15	0.01	0.70
	HC ≥ 10	15	0.00	0.00
	HC ≥ 15	15	0.00	0.00
	HC ≥ 5	80	0.05	0.00
	HC ≥ 10	80	0.00	0.00
	HC ≥ 15	80	0.00	0.00

ILD 1.01 - 3.00:

Uow (HC<5)	HC RANGE	PCT FEN	INT INS	EXT INS
0.40	HC ≥ 5	13	0.01	0.70
	HC ≥ 10	13	0.00	0.00
	HC ≥ 15	13	0.00	0.00
	HC ≥ 5	80	0.07	0.00
	HC ≥ 10	80	0.00	0.00
	HC ≥ 15	80	0.00	0.00

3.01 - 3.50	0.000 - 0.249	1.000 - 0.71	10	10	16	17	20
		0.700 - 0.60	13	13	23	22	26
		0.599 - 0.50	16	15	28	27	31
		0.499 - 0.38	19	19	36	34	38
		0.379 - 0.25	27	26	51	48	53
		0.240 - 0.00	40	45	80	61	90
	0.250 - 0.499	1.000 - 0.71	14	13	24	24	27
		0.700 - 0.60	17	17	32	31	34
		0.600 - 0.50	21	21	40	38	42
		0.499 - 0.38	27	26	51	48	53
		0.379 - 0.00	38	37	73	69	75
	0.500 +	1.000 - 0.71	18	18	33	32	36
		0.700 - 0.60	23	23	44	42	46
		0.599 - 0.50	29	28	56	52	57
		0.499 - 0.00	36	35	71	67	72

Daylight Sensing Controls

Uow (HC<5)	HC RANGE	PCT FEN	INT INS	EXT INS
0.49	HC ≥ 5	10	0.01	0.70
	HC ≥ 10	10	0.00	0.00
	HC ≥ 15	10	0.00	0.00
	HC ≥ 5	90	0.07	0.00
	HC ≥ 10	90	0.00	0.00
	HC ≥ 15	90	0.00	0.00

	Min R-Value		
WALL BELOW GRADE:	0		
UNHEATED SLAB ON GRADE:	24"	36"	48"
Horizontal	0	0	0
Vertical	0	0	0

	Max Uo
ROOF:	0.084
WALL ADJACENT TO UNCOND SPACE:	0.63
FLOOR OVER UNCOND SPACE:	0.20

ALTERNATE COMPONENT
PACKAGES FOR:

Laredo TX
Phoenix AZ
Yuma AZ

TABLE 5.4-

HDD60 = 1 - 1000
CDD65 = 3250 - 4500
VSEW =) 845
CDH80 =) 10000

INTERNAL LOAD DENSITY (ILD) RANGE	PROJECTION FACTOR (PF)	SHADING COEFF RANGE (SCx)	BASE CASE Uof 1.15 to 0.82	BASE CASE Uof 0.81 to 0	BASE CASE Uof N/A	PERIMETER DAYLIGHTING Uof 1.15 to 0.82	PERIMETER DAYLIGHTING Uof 0.81 to 0	PERIMETER DAYLIGHTING Uof 0.81 to 0, VLT ≥ SC
0 - 1.50	0.000 - 0.249	1.000 - 0.71	15	15		17	17	17
		0.709 - 0.60	19	19		22	21	22
		0.599 - 0.50	23	23		27	26	27
		0.499 - 0.38	28	28		33	33	34
		0.379 - 0.25	41	40		47	46	48
		0.249 - 0.00	76	72		88	83	85
	0.250 - 0.499	1.000 - 0.71	20	20		23	23	24
		0.709 - 0.60	26	26		30	30	30
		0.599 - 0.50	32	31		37	36	37
		0.499 - 0.38	40	40		47	46	47
		0.379 - 0.00	59	57		69	68	68
	0.500 -	1.000 - 0.71	27	27		31	31	32
		0.709 - 0.60	35	35		41	40	41
		0.599 - 0.50	44	43		51	50	51
		0.499 - 0.00	56	55		67	64	66
1.51 - 3.00	0.000 - 0.249	1.000 - 0.71	12	12		19	19	20
		0.709 - 0.60	16	16		24	24	26
		0.599 - 0.50	19	19		30	29	32
		0.499 - 0.38	24	24		38	37	40
		0.379 - 0.25	34	33		55	53	57
		0.249 - 0.00	62	59		100	92	100
	0.250 - 0.499	1.000 - 0.71	17	17		26	26	28
		0.709 - 0.60	22	21		34	33	36
		0.599 - 0.50	27	26		42	41	44
		0.499 - 0.38	34	33		55	52	56
		0.379 - 0.00	49	47		80	75	81
	0.500 -	1.000 - 0.71	23	22		36	35	37
		0.709 - 0.60	29	29		47	46	49
		0.599 - 0.50	36	36		60	57	61
		0.499 - 0.00	47	45		77	73	79

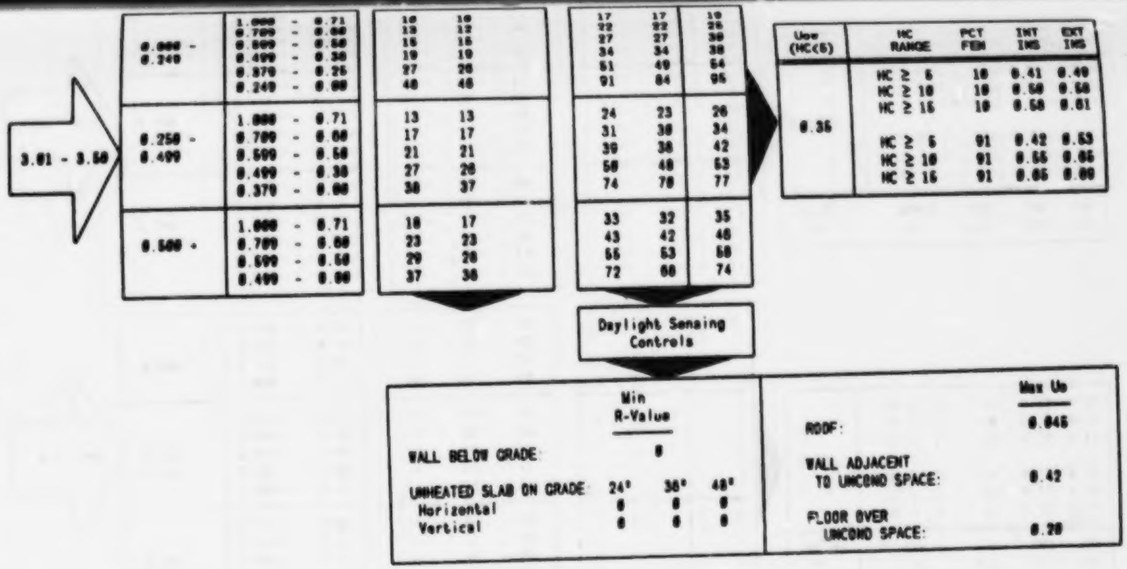
OPAQUE WALL Uow

ILD 0 - 1.50:

LIGHT WEIGHT WALL Uow (HC<5)	MASS WALL HC RANGE	PCT FEN	INT INS	EXT INS
0.35	HC ≥ 5	15	0.41	0.50
	HC ≥ 10	15	0.51	0.59
	HC ≥ 15	15	0.60	0.62
	HC ≥ 5	80	0.43	0.54
	HC ≥ 10	80	0.60	0.66
	HC ≥ 15	80	0.85	0.80

ILD 1.51 - 3.00:

LIGHT WEIGHT WALL Uow (HC<5)	MASS WALL HC RANGE	PCT FEN	INT INS	EXT INS
0.35	HC ≥ 5	12	0.41	0.50
	HC ≥ 10	12	0.51	0.59
	HC ≥ 15	12	0.60	0.62
	HC ≥ 5	92	0.43	0.54
	HC ≥ 10	92	0.58	0.66
	HC ≥ 15	92	0.66	0.79



3.01 - 3.50

0.000 - 0.249	1.000 - 0.71 0.709 - 0.60 0.599 - 0.50 0.499 - 0.38 0.379 - 0.25 0.249 - 0.00	10 13 15 19 27 40	10 12 15 19 26 40	17 22 27 34 51 91	17 22 27 34 49 84	19 26 30 38 64 95
0.250 - 0.499	1.000 - 0.71 0.709 - 0.60 0.599 - 0.50 0.499 - 0.38 0.379 - 0.00	13 17 21 27 38	13 17 21 26 37	24 31 39 50 74	23 30 38 48 70	26 34 42 53 77
0.500 +	1.000 - 0.71 0.709 - 0.60 0.599 - 0.50 0.499 - 0.00	18 23 29 37	17 23 28 36	33 43 55 72	32 42 53 68	35 46 58 74

Daylight Sensing Controls

Uow (HC<6)	HC RANGE	PCT FEN	INT INS	EXT INS
0.36	HC ≥ 6	10	0.41	0.40
	HC ≥ 10	10	0.50	0.50
	HC ≥ 16	10	0.58	0.81
	HC ≥ 6	91	0.42	0.53
	HC ≥ 10	91	0.55	0.66
	HC ≥ 16	91	0.86	0.80

	Min R-Value		
WALL BELOW GRADE:	0		
UNHEATED SLAB ON GRADE:	24"	36"	48"
Horizontal	0	0	0
Vertical	0	0	0

	Max Uo
ROOF:	0.046
WALL ADJACENT TO UNCOND SPACE:	0.42
FLOOR OVER UNCOND SPACE:	0.28

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ALTERNATE COMPONENT
PACKAGES FOR:

HDD50 = 1001 - 1750
CDD65 = 0 - 500
VSEW = 500 - 845

Astoria OR
Olympia WA
Portland OR
Salem OR
Seattle WA

Whidbey Island WA

TABLE

INTERNAL LOAD DENSITY (ILD) RANGE	PROJECTION FACTOR (PF)	SHADING COEFF RANGE (SCx)	BASE CASE Uof 0.81 to 0.46	BASE CASE Uof 0.45 to 0.39	BASE CASE Uof 0.38 to 0	PERIMETER DAYLIGHTING N/A	PERIMETER DAYLIGHTING VLT ≥ SC
0 - 1.50	0.000 - 0.240	1.000 - 0.71	24	31	33		
		0.700 - 0.60	26	37	39		
		0.599 - 0.50	27	41	44		
		0.499 - 0.38	29	45	50		
		0.379 - 0.25	30	52	59		
		0.249 - 0.00	32	60	70		
	0.250 - 0.499	1.000 - 0.71	27	39	41		
		0.700 - 0.60	29	44	48		
		0.599 - 0.50	30	48	54		
		0.499 - 0.38	31	53	60		
		0.379 - 0.00	32	56	67		
	0.500 -	1.000 - 0.71	29	48	50		
		0.700 - 0.60	31	51	58		
		0.599 - 0.50	32	56	63		
		0.499 - 0.00	32	58	68		
1.51 - 3.00	0.000 - 0.240	1.000 - 0.71	22	27	28		
		0.700 - 0.60	25	32	34		
		0.599 - 0.50	27	37	39		
		0.499 - 0.38	29	42	45		
		0.379 - 0.25	32	49	54		
		0.249 - 0.00	35	60	69		
	0.250 - 0.499	1.000 - 0.71	26	34	36		
		0.700 - 0.60	29	40	43		
		0.599 - 0.50	30	45	49		
		0.499 - 0.38	32	50	55		
		0.379 - 0.00	34	57	65		
	0.500 -	1.000 - 0.71	29	42	46		
		0.700 - 0.60	32	48	[illegible]		
		[illegible]	33	[illegible]	[illegible]		
		[illegible]	34	57	[illegible]		

OPAQUE WALL Uow

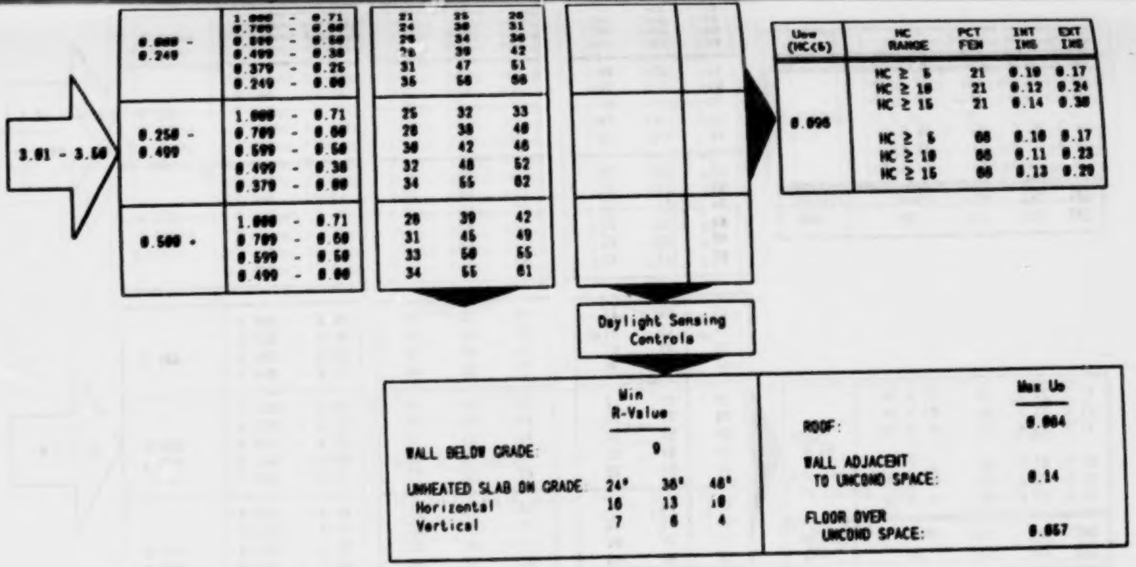
LIGHT WEIGHT WALL | MASS WALL

ILD 0 - 1.50:

Uow (HC<5)	HC RANGE	PCT FEN	INT INS	EXT INS
0.096	HC ≥ 5	24	0.10	0.16
	HC ≥ 10	24	0.11	0.19
	HC ≥ 15	24	0.12	0.24
	HC ≥ 5	70	0.10	0.14
	HC ≥ 10	70	0.11	0.19
	HC ≥ 15	70	0.12	0.23

ILD 1.51 - 3.00:

Uow (HC<5)	HC RANGE	PCT FEN	INT INS	EXT INS
0.096	HC ≥ 5	22	0.10	0.17
	HC ≥ 10	22	0.12	0.23
	HC ≥ 15	22	0.13	0.28
	HC ≥ 5	60	0.10	0.16
	HC ≥ 10	60	0.11	0.22
	HC ≥ 15	60	0.13	0.27



3.01 - 3.50

0.000 - 0.249	1.000 - 0.71	21	25	28
	0.709 - 0.60	24	30	31
	0.599 - 0.50	26	34	36
	0.499 - 0.38	26	39	42
	0.379 - 0.25	31	47	51
	0.249 - 0.00	36	56	66
0.250 - 0.499	1.000 - 0.71	25	32	33
	0.709 - 0.60	28	38	40
	0.599 - 0.50	30	42	46
	0.499 - 0.38	32	48	52
	0.379 - 0.00	34	55	62
0.500 +	1.000 - 0.71	28	39	42
	0.709 - 0.60	31	45	49
	0.599 - 0.50	33	50	55
	0.499 - 0.00	34	55	61

Uow (HC<5)	HC RANGE	PCT FEN	INT INS	EXT INS
0.096	HC ≥ 5	21	0.10	0.17
	HC ≥ 10	21	0.12	0.24
	HC ≥ 15	21	0.14	0.30
	HC ≥ 5	00	0.10	0.17
	HC ≥ 10	00	0.11	0.23
	HC ≥ 15	00	0.13	0.29

Daylight Sensing Controls

	Min R-Value		
WALL BELOW GRADE:	9		
UNHEATED SLAB ON GRADE:	24"	36"	48"
Horizontal	10	13	10
Vertical	7	6	4

	Max Uo
ROOF:	0.064
WALL ADJACENT TO UNCOND SPACE:	0.14
FLOOR OVER UNCOND SPACE:	0.057

ALTERNATE COMPONENT
PACKAGES FOR:

Asheville NC
Medford OR

TABLE

HDD65 = 1001 - 1750
CDD65 = 501 - 1100
VSEW = 500 - 845

INTERNAL LOAD DENSITY (ILD) RANGE	PROJECTION FACTOR (PF)	SHADING COEFF RANGE (SCx)	BASE CASE Uof 0.81 to 0.46	BASE CASE Uof 0.45 to 0.39	BASE CASE Uof 0.38 to 0	PERIMETER DAYLIGHTING Uof 0.81 to 0.46	PERIMETER DAYLIGHTING Uof 0.46 to 0	PERIMETER DAYLIGHTING Uof 0.38 to 0 (VLT ≥ SC)
0 - 1.50	0.000 - 0.249	1.000 - 0.71	20	24	25	22	26	27
		0.709 - 0.60	24	29	30	25	31	33
		0.599 - 0.50	26	34	35	27	36	38
		0.499 - 0.38	29	39	41	30	41	44
		0.379 - 0.25	33	47	51	33	50	55
		0.249 - 0.00	38	61	69	38	63	72
	0.250 - 0.499	1.000 - 0.71	25	31	32	26	33	36
		0.709 - 0.60	28	37	39	29	40	42
		0.599 - 0.50	31	42	45	31	45	49
		0.499 - 0.38	33	48	52	34	50	56
		0.379 - 0.00	36	57	63	37	59	67
	0.500 +	1.000 - 0.71	29	39	41	30	41	45
		0.709 - 0.60	32	46	49	33	48	53
		0.599 - 0.50	34	51	56	35	53	60
		0.499 - 0.00	36	57	63	37	59	67
1.51 - 3.00	0.000 - 0.249	1.000 - 0.71	18	20	20	22	27	28
		0.709 - 0.60	21	25	25	26	32	34
		0.599 - 0.50	24	29	30	29	37	40
		0.499 - 0.38	27	34	35	32	43	48
		0.379 - 0.25	32	42	45	36	52	58
		0.249 - 0.00	39	58	63	41	67	77
	0.250 - 0.499	1.000 - 0.71	22	26	27	27	34	36
		0.709 - 0.60	26	32	33	31	41	44
		0.599 - 0.50	29	37	39	33	46	51
		0.499 - 0.38	32	43	45	36	53	59
		0.379 - 0.00	37	53	57	40	62	71
	0.500 +	1.000 - 0.71	27	33	34	31	43	48
		0.709 - 0.60	31	40	42	35	50	55
		0.599 - 0.50	33	46	48	37	56	63
		0.499 - 0.00	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	71

OPAQUE WALL Uow

ILD RANGE	LIGHT WEIGHT WALL Uow (HC<5)	MASS WALL HC RANGE	PCT FEN	INT INS	EXT INS
0 - 1.50	0.10	HC ≥ 5	20	0.11	0.15
		HC ≥ 10	20	0.13	0.19
		HC ≥ 15	20	0.15	0.20
		HC ≥ 5	72	0.11	0.14
		HC ≥ 10	72	0.13	0.17
		HC ≥ 15	72	0.14	0.18
1.51 - 3.00	0.10	HC ≥ 5	18	0.11	0.17
		HC ≥ 10	18	0.14	0.22
		HC ≥ 15	18	0.18	0.24
		HC ≥ 5	77	0.11	0.15
		HC ≥ 10	77	0.13	0.19
		HC ≥ 15	77	0.16	0.20

3.01 - 3.50

0.000 - 0.249	1.000 - 0.71	10	10	10	22	29	27
	0.709 - 0.60	19	22	22	26	31	33
	0.599 - 0.50	22	26	26	28	36	39
	0.499 - 0.38	25	30	31	31	42	45
	0.379 - 0.25	29	38	40	35	51	57
	0.249 - 0.00	36	52	57	40	65	75
0.250 - 0.499	1.000 - 0.71	20	23	23	26	33	35
	0.709 - 0.60	24	28	29	30	40	43
	0.599 - 0.50	26	33	34	32	45	50
	0.499 - 0.38	29	38	40	35	51	58
	0.379 - 0.00	34	47	51	39	61	70
0.500 +	1.000 - 0.71	24	29	30	31	41	45
	0.709 - 0.60	28	35	37	34	48	54
	0.599 - 0.50	31	41	43	36	54	61
	0.499 - 0.00	34	47	50	38	60	70

Uow (HC<5)	HC RANGE	PCT FEN	INT INS	EXT INS
0.10	HC ≥ 5	10	0.11	0.17
	HC ≥ 10	10	0.15	0.23
	HC ≥ 15	10	0.18	0.28
	HC ≥ 5	75	0.11	0.15
	HC ≥ 10	75	0.13	0.19
	HC ≥ 15	75	0.15	0.20

Daylight Sensing Controls

	Min R-Value		
WALL BELOW GRADE:	8		
UNHEATED SLAB ON GRADE:	24"	36"	48"
Horizontal	15	12	10
Vertical	7	5	4

	Max Uo
ROOF:	0.063
WALL ADJACENT TO UNCOND SPACE:	0.16
FLOOR OVER UNCOND SPACE:	0.084

ALTERNATE COMPONENT
PACKAGES FOR:

HDD60 = 1001 - 1750
CDD65 = 1 - 1150
VSEW = > 845

Prescott AZ
Winslow AZ
Yucca Flats NV

TABLE 6-1

Uof

INTERNAL LOAD DENSITY (ILD) RANGE	PROJECTION FACTOR (PF)	SHADING COEFF RANGE (SCx)	BASE CASE 0.81 to 0.46	BASE CASE 0.45 to 0.39	BASE CASE 0.38 to 0	PERIMETER DAYLIGHTING 0.81 to 0.46	PERIMETER DAYLIGHTING 0.45 to 0	PERIMETER DAYLIGHTING 0.38 to 0 (VLT ≥ SC)
0 - 1.50	0.000 - 0.249	1.000 - 0.71	15	17	17	17	19	19
		0.709 - 0.60	18	21	21	20	23	24
		0.599 - 0.50	21	24	26	22	27	28
		0.499 - 0.38	24	29	30	25	31	33
		0.379 - 0.25	28	36	38	29	39	42
		0.249 - 0.00	35	50	54	36	53	58
	0.250 - 0.499	1.000 - 0.71	19	22	23	21	25	26
		0.709 - 0.60	23	27	28	24	30	31
		0.599 - 0.50	25	32	33	27	34	37
		0.499 - 0.38	28	37	39	30	40	43
		0.379 - 0.00	33	46	49	34	48	53
	0.500 +	1.000 - 0.71	24	29	30	26	31	33
		0.709 - 0.60	27	34	36	28	37	40
		0.599 - 0.50	30	39	42	31	42	46
		0.499 - 0.00	33	45	49	34	48	53
1.51 - 3.00	0.000 - 0.249	1.000 - 0.71	13	13	14	17	18	20
		0.709 - 0.60	15	17	17	20	23	25
		0.599 - 0.50	18	20	20	22	26	29
		0.499 - 0.38	20	23	24	25	31	34
		0.379 - 0.25	25	30	31	30	39	44
		0.249 - 0.00	33	43	46	37	53	62
	0.250 - 0.499	1.000 - 0.71	18	18	18	21	24	26
		0.709 - 0.60	19	22	22	24	29	32
		0.599 - 0.50	22	26	26	27	34	38
		0.499 - 0.38	25	30	31	30	40	44
		0.379 - 0.00	30	39	40	35	49	58
	0.500 +	1.000 - 0.71	20	23	24	25	31	34
		0.709 - 0.60	24	28	29	29	37	41
		0.599 - 0.50	27	33	34	32	42	48
		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

OPAQUE WALL Uow

LIGHT WEIGHT WALL | MASS WALL

ILD 0 - 1.50:

Uow (HC<5)	HC RANGE	PCT FEN	INT INS	EXT INS
0.11	HC ≥ 5	15	0.12	0.17
	HC ≥ 10	15	0.14	0.21
	HC ≥ 15	15	0.17	0.23
	HC ≥ 5	50	0.11	0.16
	HC ≥ 10	50	0.14	0.20
	HC ≥ 15	50	0.10	0.21

ILD 1.51 - 3.00:

Uow (HC<5)	HC RANGE	PCT FEN	INT INS	EXT INS
0.11	HC ≥ 5	13	0.12	0.19
	HC ≥ 10	13	0.16	0.26
	HC ≥ 15	13	0.20	0.27
	HC ≥ 5	62	0.12	0.17
	HC ≥ 10	62	0.15	0.22
	HC ≥ 15	62	0.18	0.23

3.01 - 3.50

0.000 - 0.249	1.000 - 0.71	11	11	11	15	17	19
	0.709 - 0.60	13	14	14	18	21	24
	0.599 - 0.50	16	17	17	21	25	28
	0.499 - 0.38	19	20	20	24	29	33
	0.379 - 0.25	22	26	27	28	37	42
	0.249 - 0.00	29	37	39	35	50	60
0.250 - 0.499	1.000 - 0.71	14	15	15	20	23	25
	0.709 - 0.60	17	19	19	23	28	31
	0.599 - 0.50	19	22	22	25	32	36
	0.499 - 0.38	22	26	27	28	37	43
	0.379 - 0.00	27	33	35	33	40	54
0.500 +	1.000 - 0.71	17	19	20	24	29	33
	0.709 - 0.60	21	24	25	27	35	40
	0.599 - 0.50	23	28	29	30	40	46
	0.499 - 0.00	26	33	34	33	45	53

Uow (HC<5)	HC RANGE	PCT FEN	INT INS	EXT INS
0.11	HC ≥ 5	11	0.12	0.19
	HC ≥ 10	11	0.18	0.20
	HC ≥ 15	11	0.21	0.26
	HC ≥ 5	50	0.12	0.17
	HC ≥ 10	50	0.15	0.22
	HC ≥ 15	50	0.18	0.24

Daylight Sensing Controls

	Min R-Value		
WALL BELOW GRADE:	8		
UNHEATED SLAB ON GRADE:	24"	30"	48"
Horizontal	15	12	10
Vertical	7	5	4

	Max Uo
ROOF:	0.056
WALL ADJACENT TO UNCOND SPACE:	0.10
FLOOR OVER UNCOND SPACE:	0.066

ALTERNATE COMPONENT PACKAGES FOR:

HDD60 = 1001 - 1750
CDD65 = 1151 - 2000
VSEW = 600 - 845

Charlotte NC
Chattanooga TN
Greensboro NC
Knoxville TN
Nashville TN

Norfolk VA
Patuxent MD
Raleigh NC
Richmond VA
Roanoke VA

TABLE 6.4-

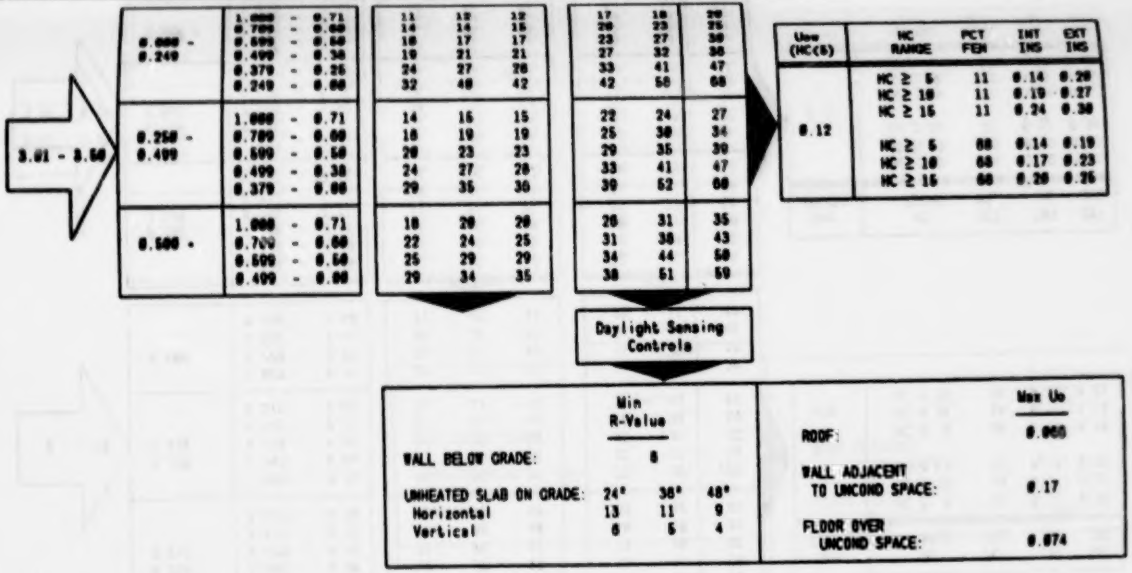
INTERNAL LOAD DENSITY (ILD) RANGE	PROJECTION FACTOR (PF)	SHADING COEFF RANGE (SCx)	BASE CASE Uof 0.81 to 0.40	BASE CASE Uof 0.45 to 0.39	BASE CASE Uof 0.38 to 0	PERIMETER DAYLIGHTING Uof 0.81 to 0.40	PERIMETER DAYLIGHTING Uof 0.45 to 0	PERIMETER DAYLIGHTING Uof 0.38 to 0 (VLT ≥ SC)
0 - 1.50	0.000 - 0.249	1.000 - 0.71	18	18	18	18	20	20
		0.709 - 0.60	20	22	22	21	24	25
		0.599 - 0.50	23	26	26	24	28	30
		0.499 - 0.38	26	30	31	28	33	35
		0.379 - 0.25	32	39	40	34	43	46
		0.249 - 0.00	41	50	59	43	60	66
	0.250 - 0.499	1.000 - 0.71	21	23	24	23	26	27
		0.709 - 0.60	25	28	29	27	31	33
		0.599 - 0.50	28	33	34	30	37	39
		0.499 - 0.38	32	39	41	34	43	46
		0.379 - 0.00	38	50	52	40	54	58
	0.500 -	1.000 - 0.71	26	30	30	28	33	34
		0.709 - 0.60	30	36	37	32	40	42
		0.599 - 0.50	34	42	44	36	46	49
		0.499 - 0.00	38	49	51	40	53	56
1.51 - 3.00	0.000 - 0.249	1.000 - 0.71	13	14	14	18	20	21
		0.709 - 0.60	16	17	17	22	24	27
		0.599 - 0.50	19	21	21	25	29	31
		0.499 - 0.38	22	25	25	29	34	37
		0.379 - 0.25	28	32	33	35	44	49
		0.249 - 0.00	37	47	49	45	62	70
	0.250 - 0.499	1.000 - 0.71	17	18	19	23	26	28
		0.709 - 0.60	21	23	23	27	32	35
		0.599 - 0.50	24	27	27	31	37	41
		0.499 - 0.38	28	32	33	35	44	49
		0.379 - 0.00	34	41	43	41	55	63
	0.500 -	1.000 - 0.71	21	24	24	28	33	36
		0.709 - 0.60	26	29	30	33	40	45
		0.599 - 0.50	29	34	35	37	47	52
		0.499 - 0.00	[illegible]	41	42	41	55	61

OPAQUE WALL Uow

LIGHT WEIGHT WALL — MASS WALL

Uow (HC<5)	HC RANGE	PCT FEN	INT INS	EXT INS
0.12	HC ≥ 5	10	0.14	0.18
	HC ≥ 10	10	0.17	0.22
	HC ≥ 15	10	0.19	0.24
	HC ≥ 5	60	0.14	0.18
	HC ≥ 10	60	0.16	0.21
	HC ≥ 15	60	0.19	0.23

Uow (HC<5)	HC RANGE	PCT FEN	INT INS	EXT INS
0.12	HC ≥ 5	13	0.14	0.20
	HC ≥ 10	13	0.18	0.20
	HC ≥ 15	13	0.23	0.20
	HC ≥ 5	70	0.14	0.18
	HC ≥ 10	70	0.17	0.23
	HC ≥ 15	70	0.20	0.25



0.000 - 0.249	1.000 - 0.71	11	12	12	17	18	20
	0.700 - 0.60	14	14	15	20	23	25
	0.599 - 0.50	16	17	17	23	27	30
	0.499 - 0.38	19	21	21	27	32	38
	0.379 - 0.25	24	27	28	33	41	47
	0.249 - 0.00	32	40	42	42	50	60
0.250 - 0.499	1.000 - 0.71	14	16	15	22	24	27
	0.700 - 0.60	18	19	19	25	30	34
	0.599 - 0.50	20	23	23	29	35	39
	0.499 - 0.38	24	27	28	33	41	47
	0.379 - 0.00	29	35	36	39	52	60
0.500 +	1.000 - 0.71	18	20	20	28	31	35
	0.700 - 0.60	22	24	25	31	38	43
	0.599 - 0.50	25	29	29	34	44	50
	0.499 - 0.00	29	34	35	38	51	59

Daylight Sensing Controls

Uow (HC<5)	HC RANGE	PCT FEN	INT INS	EXT INS
0.12	HC ≥ 5	11	0.14	0.20
	HC ≥ 10	11	0.19	0.27
	HC ≥ 15	11	0.24	0.30
	HC ≥ 5	00	0.14	0.19
	HC ≥ 10	00	0.17	0.23
	HC ≥ 15	00	0.20	0.26

	Min R-Value		
WALL BELOW GRADE:	0		
UNHEATED SLAB ON GRADE:	24"	30"	48"
Horizontal	13	11	9
Vertical	6	5	4

	Max Uo
ROOF:	0.060
WALL ADJACENT TO UNCOND SPACE:	0.17
FLOOR OVER UNCOND SPACE:	0.074

ALTERNATE COMPONENT PACKAGES FOR:

HDD65 = 1001 - 1750
CDD65 = 1151 - 2000
VSEF = > 845

Albuquerque NM
Amarillo TX
Lubbock TX
Oklahoma City OK
Roswell NM

Truth or Consequences NM
Tucumcari NM

TABLE 8.6

INTERNAL LOAD DENSITY (ILD) RANGE	PROJECTION FACTOR (PF)	SHADING COEFF RANGE (SCx)	BASE CASE Uof 0.81 to 0.46	BASE CASE Uof 0.45 to 0.39	BASE CASE Uof 0.38 to 0	PERIMETER DAYLIGHTING Uof 0.81 to 0.46	PERIMETER DAYLIGHTING Uof 0.45 to 0	PERIMETER DAYLIGHTING Uof 0.38 to 0 (VLT ≥ SC)
0 - 1.50	0.000 - 0.249	1.000 - 0.71	14	16	18	15	17	17
		0.700 - 0.60	17	19	19	18	21	22
		0.599 - 0.50	19	22	23	20	24	25
		0.499 - 0.38	22	26	27	23	28	30
		0.379 - 0.25	27	33	35	28	30	36
		0.249 - 0.00	33	47	50	35	49	54
	0.250 - 0.499	1.000 - 0.71	18	20	21	19	22	23
		0.700 - 0.60	21	25	26	22	27	28
		0.599 - 0.50	24	29	30	25	31	33
		0.499 - 0.38	27	34	36	28	38	39
		0.379 - 0.00	31	42	45	32	46	49
	0.500 -	1.000 - 0.71	22	26	27	23	28	30
		0.700 - 0.60	25	31	33	27	34	36
		0.599 - 0.50	28	38	38	29	39	42
		0.499 - 0.00	31	42	45	32	46	49
1.51 - 3.00	0.000 - 0.249	1.000 - 0.71	11	12	12	15	18	18
		0.700 - 0.60	14	15	15	18	20	22
		0.599 - 0.50	16	18	18	20	23	26
		0.499 - 0.38	19	21	22	23	28	31
		0.379 - 0.25	23	27	28	28	35	40
		0.249 - 0.00	31	39	42	36	49	57
	0.250 - 0.499	1.000 - 0.71	15	18	18	19	22	24
		0.700 - 0.60	18	20	20	22	26	29
		0.599 - 0.50	20	23	24	25	30	34
		0.499 - 0.38	23	27	28	28	38	40
		0.379 - 0.00	28	36	37	33	46	61
	0.500 -	1.000 - 0.71	18	21	21	23	28	31
		0.700 - 0.60	22	25	28	27	33	37

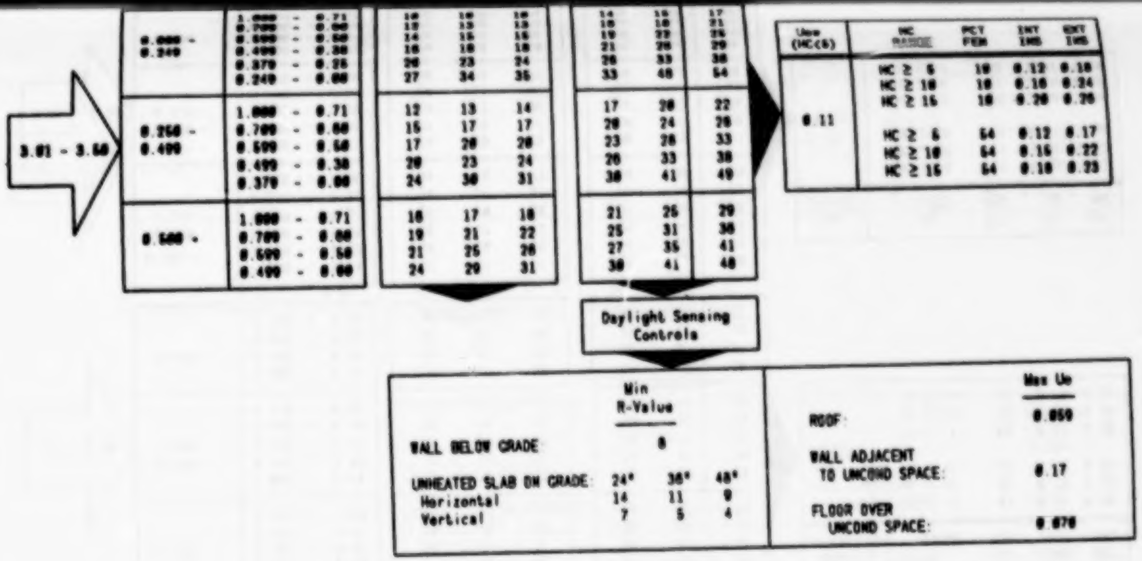
OPAQUE WALL Uow

ILD 0 - 1.50:

LIGHT WEIGHT WALL Uow (HC<5)	MASS WALL HC RANGE	PCT FEN	INT INS	EXT INS
0.11	HC ≥ 5	14	0.12	0.18
	HC ≥ 10	14	0.14	0.21
	HC ≥ 15	14	0.17	0.22
	HC ≥ 5	64	0.11	0.18
	HC ≥ 10	64	0.14	0.19
	HC ≥ 15	64	0.16	0.21

ILD 1.51 - 3.00:

LIGHT WEIGHT WALL Uow (HC<5)	MASS WALL HC RANGE	PCT FEN	INT INS	EXT INS
0.11	HC ≥ 5	11	0.12	0.18
	HC ≥ 10	11	0.15	0.23
	HC ≥ 15	11	0.18	0.26
	HC ≥ 5	67	0.12	0.17
	HC ≥ 10	67	0.15	0.21
	HC ≥ 15	67	0.17	0.23



3.01 - 3.60

0.000 - 0.249	1.000 - 0.71	10	10	10	14	16	17
	0.700 - 0.60	12	13	13	18	18	21
	0.599 - 0.50	14	16	16	19	22	25
	0.499 - 0.38	18	18	18	21	28	29
	0.379 - 0.25	20	23	24	26	33	38
	0.249 - 0.00	27	34	35	33	48	54
0.250 - 0.499	1.000 - 0.71	12	13	14	17	20	22
	0.700 - 0.60	15	17	17	20	24	28
	0.599 - 0.50	17	20	20	23	28	33
	0.499 - 0.38	20	23	24	26	33	38
	0.379 - 0.00	24	30	31	30	41	49
0.500 +	1.000 - 0.71	18	17	18	21	26	29
	0.700 - 0.60	19	21	22	25	31	38
	0.599 - 0.50	21	25	28	27	35	41
	0.499 - 0.00	24	29	31	30	41	48

Uow (HC<6)	HC RANGE	PCT FEN	INT INS	EXT INS
0.11	HC ≥ 6	10	0.12	0.18
	HC ≥ 10	10	0.18	0.24
	HC ≥ 16	10	0.20	0.20
	HC ≥ 6	64	0.12	0.17
	HC ≥ 10	64	0.16	0.22
	HC ≥ 16	64	0.18	0.23

Daylight Sensing Controls

	Min R-Value		
WALL BELOW GRADE	8		
UNHEATED SLAB ON GRADE:	24"	36"	48"
Horizontal	14	11	9
Vertical	7	5	4

	Max Uo
ROOF:	0.059
WALL ADJACENT TO UNCOND SPACE:	0.17
FLOOR OVER UNCOND SPACE:	0.078

TABLE

ALTERNATE COMPONENT
PACKAGES FOR:

HDD60 = 1001 - 1750
CDD65 = 2001 - 3250
VSEW = 500 - 845

Fort Smith AR
Memphis TN
Tulsa OK

INTERNAL LOAD DENSITY (ILD) RANGE	PROJECTION FACTOR (PF)	SHADING COEFF RANGE (SCx)	BASE CASE Uof 0.81 to 0.46	BASE CASE Uof 0.45 to 0.39	BASE CASE Uof 0.38 to 0	PERIMETER DAYLIGHTING Uof 0.81 to 0.46	PERIMETER DAYLIGHTING Uof 0.45 to 0	PERIMETER DAYLIGHTING Uof 0.38 to 0 VLT ≥ SC
0 - 1.50	0.000 - 0.249	1.000 - 0.71	14	16	16	16	17	17
		0.709 - 0.60	17	19	19	19	21	22
		0.599 - 0.50	20	22	22	22	26	26
		0.499 - 0.38	24	26	27	26	29	31
		0.379 - 0.25	30	35	36	32	36	41
		0.249 - 0.00	41	52	64	43	57	62
	0.250 - 0.499	1.000 - 0.71	18	20	20	20	22	23
		0.709 - 0.60	22	25	25	24	27	29
		0.599 - 0.50	26	29	30	28	32	34
		0.499 - 0.38	30	35	36	32	39	41
		0.379 - 0.00	37	46	47	40	50	53
	0.500 -	1.000 - 0.71	23	26	26	25	29	30
		0.709 - 0.60	28	32	32	30	35	37
		0.599 - 0.50	32	37	38	34	41	44
		0.499 - 0.00	36	44	46	39	49	52
1.51 - 3.00	0.000 - 0.249	1.000 - 0.71	11	11	11	15	18	18
		0.709 - 0.60	13	14	14	19	20	22
		0.599 - 0.50	16	17	17	22	24	27
		0.499 - 0.38	19	20	20	25	29	32
		0.379 - 0.25	24	27	27	32	36	43
		0.249 - 0.00	34	41	42	43	56	65
	0.250 - 0.499	1.000 - 0.71	14	15	15	20	21	24
		0.709 - 0.60	17	19	19	24	27	30
		0.599 - 0.50	20	22	22	28	32	35
		0.499 - 0.38	24	27	27	32	38	43
		0.379 - 0.00	30	35	36	39	46	56
	0.500 -	1.000 - 0.71	18	19	19	25	28	31
		0.709 - 0.60	22	24	24	30	34	39
		0.599 - 0.50	25	29	29	34	40	46
		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

OPAQUE WALL Uow

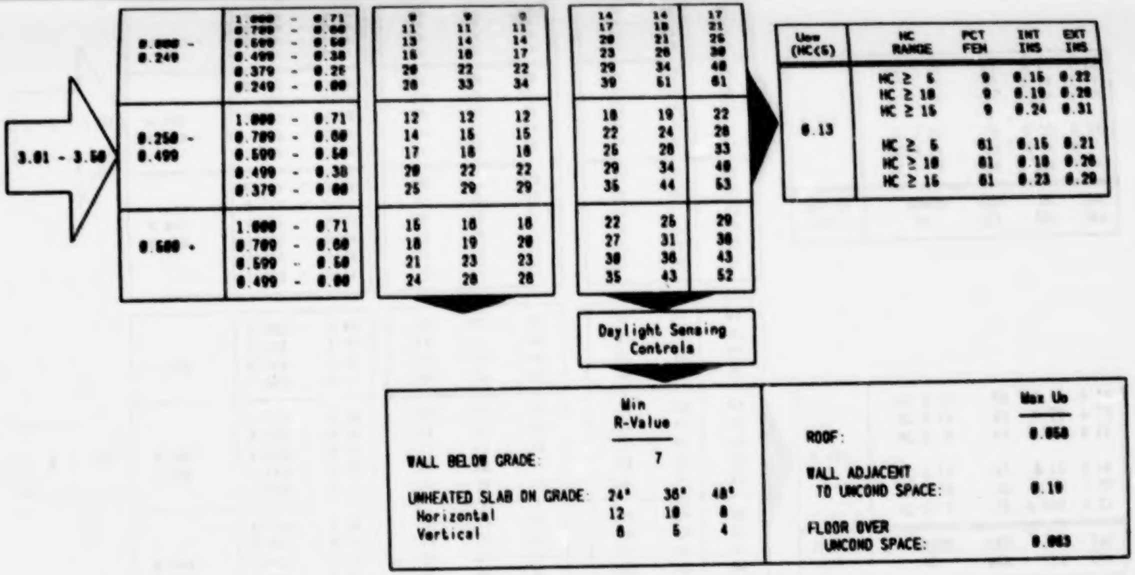
LIGHT WEIGHT WALL | MASS WALL

ILD 0 - 1.50:

Uow (HC<5)	HC RANGE	PCT FEN	INT INS	EXT INS
0.13	HC ≥ 5	14	0.14	0.20
	HC ≥ 10	14	0.18	0.25
	HC ≥ 15	14	0.22	0.27
	HC ≥ 5	02	0.14	0.20
	HC ≥ 10	02	0.18	0.24
	HC ≥ 15	02	0.21	0.20

ILD 1.51 - 3.00:

Uow (HC<5)	HC RANGE	PCT FEN	INT INS	EXT INS
0.13	HC ≥ 5	11	0.15	0.21
	HC ≥ 10	11	0.19	0.27
	HC ≥ 15	11	0.24	0.30
	HC ≥ 5	06	0.14	0.20
	HC ≥ 10	06	0.18	0.20
	HC ≥ 15	06	0.23	0.20



3.01 - 3.50

0.000 - 0.249	1.000 - 0.71 0.700 - 0.60 0.599 - 0.50 0.499 - 0.38 0.379 - 0.25 0.249 - 0.00	9 11 13 16 20 28	9 11 14 18 22 33	9 11 14 17 22 34
0.250 - 0.499	1.000 - 0.71 0.700 - 0.60 0.599 - 0.50 0.499 - 0.38 0.379 - 0.00	12 14 17 20 25	12 15 18 22 29	12 15 18 22 29
0.500 +	1.000 - 0.71 0.700 - 0.60 0.599 - 0.50 0.499 - 0.00	16 18 21 24	18 19 23 28	18 20 23 28

14 17 20 23 29 39	14 18 21 28 34 51	17 21 26 30 40 61
18 22 26 29 35	19 24 28 34 44	22 28 33 40 53
22 27 30 35	26 31 38 43	29 38 43 52

Daylight Sensing Controls

Uow (HC<5)	HC RANGE	PCT FEN	INT INS	EXT INS
0.13	HC ≥ 5	0	0.15	0.22
	HC ≥ 10	0	0.19	0.28
	HC ≥ 15	0	0.24	0.31
	HC ≥ 5	61	0.15	0.21
	HC ≥ 10	61	0.18	0.26
	HC ≥ 15	61	0.23	0.29

	Min R-Value		
WALL BELOW GRADE:	7		
UNHEATED SLAB ON GRADE:	24"	36"	48"
Horizontal	12	10	8
Vertical	6	5	4

	Max Uo
ROOF:	0.050
WALL ADJACENT TO UNCOND SPACE:	0.10
FLOOR OVER UNCOND SPACE:	0.083

TABLE 8.4g

ALTERNATE COMPONENT
PACKAGES FOR:

HDD65 = 1751 - 2000
CDD65 = 0 - 1150
VSEB = 600 - 845

Baltimore MD	Dayton OH	New York (LAG) NY	
Boston MA	Harrisburg PA	Philadelphia PA	
Charleston WV	Lewiston ID	Redmond OR	
Columbus OH	Newark NJ	Washington DC	
Covington KY	New York NY	Yakima WA	

INTERNAL LOAD DENSITY (ILD) RANGE	PROJECTION FACTOR (PF)	SHADING COEFF RANGE (SCx)	BASE CASE Uof 0.88 to 0.46	BASE CASE Uof 0.46 to 0.39	BASE CASE Uof 0.38 to 0	PERIMETER DAYLIGHTING Uof 0.88 to 0.46	PERIMETER DAYLIGHTING Uof 0.46 to 0	PERIMETER DAYLIGHTING Uof 0.38 to 0 (VLT ≥ SC)
0 - 1.60	0.000 - 0.249	1.000 - 0.71	22	26	27	23	27	29
		0.709 - 0.60	25	30	32	26	32	34
		0.599 - 0.50	27	34	37	28	36	39
		0.499 - 0.38	30	39	42	30	40	44
		0.379 - 0.25	33	45	51	33	46	52
		0.249 - 0.00	36	54	63	36	54	63
	0.250 - 0.499	1.000 - 0.71	26	33	35	27	34	37
		0.709 - 0.60	29	38	41	30	39	43
		0.599 - 0.50	31	42	46	31	43	48
		0.499 - 0.38	33	46	52	33	47	53
		0.379 - 0.00	36	52	60	35	52	61
	0.500 -	1.000 - 0.71	30	39	43	30	41	45
		0.709 - 0.60	33	45	49	33	46	52
		0.599 - 0.50	34	49	55	34	49	56
		0.499 - 0.00	36	52	60	36	53	61
1.61 - 3.00	0.000 - 0.249	1.000 - 0.71	20	22	22	24	28	29
		0.709 - 0.60	23	26	27	27	33	35
		0.599 - 0.50	25	30	32	29	37	40
		0.499 - 0.38	26	35	37	32	41	46
		0.379 - 0.25	32	42	46	36	48	55
		0.249 - 0.00	36	53	60	39	56	66
	0.250 - 0.499	1.000 - 0.71	24	28	29	28	35	37
		0.709 - 0.60	27	33	35	31	40	44
		0.599 - 0.50	30	38	40	33	44	50
		0.499 - 0.38	33	42	46	35	49	56
		0.379 - 0.00	36	50	55	38	55	66
	0.500 -	1.000 - 0.71	29	35	37	32	42	47
		0.709 - 0.60	32	40	43	34	47	54
		0.599 - 0.50	34	45	49	36	51	59
		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

OPAQUE WALL Uow

INTERNAL LOAD DENSITY (ILD) RANGE	LIGHT WEIGHT WALL Uow (HC(5))	MASS WALL HC RANGE	MASS WALL PCT FEN	MASS WALL INT INS	MASS WALL EXT INS
0 - 1.60	0.088	HC ≥ 5	22	0.090	0.12
		HC ≥ 10	22	0.11	0.15
		HC ≥ 15	22	0.12	0.18
		HC ≥ 5	63	0.093	0.11
		HC ≥ 10	63	0.10	0.13
		HC ≥ 15	63	0.11	0.14
1.61 - 3.00	0.088	HC ≥ 5	20	0.097	0.14
		HC ≥ 10	20	0.11	0.17
		HC ≥ 15	20	0.13	0.18
		HC ≥ 5	60	0.090	0.12
		HC ≥ 10	60	0.10	0.14
		HC ≥ 15	60	0.11	0.16

3.01 - 3.50	0.000 - 0.249	1.000 - 0.71	18	19	20	23	27	28
		0.700 - 0.60	21	23	24	26	32	34
		0.600 - 0.50	23	27	28	29	36	39
		0.499 - 0.38	26	31	33	31	41	45
		0.379 - 0.25	30	38	41	34	47	54
		0.249 - 0.00	38	49	55	39	57	67
	0.250 - 0.499	1.000 - 0.71	22	25	28	27	34	37
		0.709 - 0.60	25	30	31	30	39	44
		0.599 - 0.50	28	34	36	33	43	49
		0.499 - 0.38	30	39	42	35	48	55
		0.379 - 0.00	34	48	51	38	54	64
	0.500 +	1.000 - 0.71	26	31	33	31	41	48
		0.709 - 0.60	29	36	39	34	46	53
		0.599 - 0.50	32	41	44	36	50	59
		0.499 - 0.00	34	48	50	38	54	64

Daylight Sensing
Controls

Uoe (HC<5)	HC RANGE	PCT FEN	INT INS	EXT INS
0.060	HC ≥ 5	10	0.090	0.14
	HC ≥ 10	10	0.11	0.18
	HC ≥ 15	10	0.13	0.19
	HC ≥ 5	07	0.095	0.12
	HC ≥ 10	07	0.10	0.14
	HC ≥ 15	07	0.11	0.16

	Min R-Value		
WALL BELOW GRADE:	9		
UNHEATED SLAB ON GRADE:	24"	36"	48"
Horizontal	17	14	11
Vertical	8	6	4

	Max Uo
ROOF:	0.055
WALL ADJACENT TO UNCOND SPACE:	0.13
FLOOR OVER UNCOND SPACE:	0.048

ALTERNATE COMPONENT PACKAGES FOR:

HDD65 = 2001 - 3200
CDD65 = 0 - 1150
VSEW = 500 - 845

Akron OH
Allentown PA
Burlington IA
Chicago IL
Detroit MI

Erie PA
Hartford CT
Indianapolis IN
Omaha NE
Pittsburgh PA

Providence RI
South Bend IN
Spokane WA
Toledo OH
Youngstown OH

TABLE 5.4

INTERNAL LOAD DENSITY (ILD) RANGE	PROJECTION FACTOR (PF)	SHADING COEFF RANGE (SCx)	BASE CASE Uof 0.60 to 0.46	BASE CASE Uof 0.45 to 0.39	BASE CASE Uof 0.38 to 0	PERIMETER DAYLIGHTING Uof 0.60 to 0.46	PERIMETER DAYLIGHTING Uof 0.45 to 0	PERIMETER DAYLIGHTING Uof 0.38 to 0 VLT ≥ SC
0 - 1.50	0.000 - 0.249	1.000 - 0.71	21	26	28	21	27	29
		0.709 - 0.60	24	30	33	23	31	34
		0.599 - 0.50	25	34	37	25	34	38
		0.499 - 0.38	26	37	41	26	37	42
		0.379 - 0.25	28	41	47	27	40	47
		0.249 - 0.00	29	46	54	28	44	53
	0.250 - 0.499	1.000 - 0.71	25	32	35	24	33	37
		0.709 - 0.60	26	36	41	26	37	41
		0.599 - 0.50	27	39	44	27	39	45
		0.499 - 0.38	28	42	48	27	41	48
		0.379 - 0.00	29	45	53	28	44	52
	0.500 -	1.000 - 0.71	27	38	42	26	38	43
		0.709 - 0.60	28	41	47	27	41	48
		0.599 - 0.50	29	44	51	28	43	50
		0.499 - 0.00	30	46	54	29	44	53
1.51 - 3.00	0.000 - 0.249	1.000 - 0.71	19	23	23	22	27	29
		0.709 - 0.60	22	27	28	24	32	34
		0.599 - 0.50	24	30	32	26	35	39
		0.499 - 0.38	26	34	37	28	38	43
		0.379 - 0.25	29	40	44	30	43	49
		0.249 - 0.00	32	47	54	32	49	57
	0.250 - 0.499	1.000 - 0.71	23	28	30	25	33	37
		0.709 - 0.60	26	33	36	27	38	43
		0.599 - 0.50	28	36	40	29	40	47
		0.499 - 0.38	29	40	45	30	43	50
		0.379 - 0.00	31	46	52	32	47	56
	0.500 -	1.000 - 0.71	28	34	37	28	39	45
		0.709 - 0.60	29	39	43	29	42	50
		0.599 - 0.50	30	42	47	30	45	53
		0.499 - 0.00	32	46	52	32	47	60

OPAQUE WALL Uow

LIGHT WEIGHT WALL / MASS WALL

ILD 0 - 1.50:

Uow (HC<5)	HC RANGE	PCT FEN	INT INS	EXT INS
0.088	HC ≥ 5	21	0.084	0.10
	HC ≥ 10	21	0.092	0.12
	HC ≥ 15	21	0.099	0.12
	HC ≥ 5	54	0.083	0.10
	HC ≥ 10	54	0.090	0.11
	HC ≥ 15	54	0.096	0.12

ILD 1.51 - 3.00:

Uow (HC<5)	HC RANGE	PCT FEN	INT INS	EXT INS
0.088	HC ≥ 5	19	0.086	0.11
	HC ≥ 10	19	0.095	0.13
	HC ≥ 15	19	0.10	0.14
	HC ≥ 5	57	0.083	0.10
	HC ≥ 10	57	0.089	0.11
	HC ≥ 15	57	0.096	0.12

3.01 - 3.50

0.000 - 0.249	1.000 - 0.71	18	20	21	22	27	29
	0.709 - 0.60	20	24	25	24	31	34
	0.599 - 0.50	23	28	29	26	34	38
	0.499 - 0.38	25	31	34	27	38	43
	0.379 - 0.25	28	37	41	30	43	49
	0.249 - 0.00	31	45	51	32	48	57
0.250 - 0.499	1.000 - 0.71	21	26	27	25	33	36
	0.709 - 0.60	24	30	32	27	37	42
	0.599 - 0.50	26	34	37	28	40	46
	0.499 - 0.38	28	37	41	30	43	50
	0.379 - 0.00	30	43	48	32	47	55
0.500 +	1.000 - 0.71	25	31	34	28	38	44
	0.709 - 0.60	27	36	39	29	42	49
	0.599 - 0.50	29	39	44	30	44	53
	0.499 - 0.00	30	43	48	31	47	58

Daylight Sensing Controls

Uow (HC<5)	HC RANGE	PCT FEN	INT INS	EXT INS
0.080	HC ≥ 5	10	0.086	0.11
	HC ≥ 10	10	0.097	0.14
	HC ≥ 15	10	0.10	0.15
	HC ≥ 5	57	0.083	0.10
	HC ≥ 10	57	0.090	0.12
	HC ≥ 15	57	0.094	0.12

	Min R-Value		
WALL BELOW GRADE:	10		
UNHEATED SLAB ON GRADE:	24"	36"	48"
Horizontal	17	14	11
Vertical	6	6	4

	Max Uo
ROOF:	0.054
WALL ADJACENT TO UNCOND SPACE:	0.13
FLOOR OVER UNCOND SPACE:	0.047

ALTERNATE COMPONENT PACKAGES FOR:

HDD65 = 1751 - 3200
CDD65 = 0 - 1150
VSER = > 845

Boise ID	Goodland KS	Salt Lake City UT	TABLE 5.4
Cedar UT	Lovelock NV	Tonopah NV	
Clayton NM	Mount Shasta CA	Winnemucca NV	
Colorado Springs CO	Pueblo CO		
Denver CO	Reno NV		

INTERNAL LOAD DENSITY (ILD) RANGE	PROJECTION FACTOR (PF)	SHADING COEFF RANGE (SCx)	BASE CASE Uof 0.60 to 0.46	BASE CASE Uof 0.45 to 0.39	BASE CASE Uof 0.30 to 0	PERIMETER DAYLIGHTING Uof 0.60 to 0.40	PERIMETER DAYLIGHTING Uof 0.45 to 0	PERIMETER DAYLIGHTING Uof 0.30 to 0 (VLT ≥ SC)
0 - 1.50	0.000 - 0.249	1.000 - 0.71	22	24	25	23	26	27
		0.700 - 0.60	25	29	31	26	31	33
		0.600 - 0.50	27	33	35	28	36	38
		0.400 - 0.38	30	38	41	30	39	43
		0.370 - 0.25	33	45	49	33	46	52
		0.240 - 0.00	37	54	62	37	56	63
	0.250 - 0.499	1.000 - 0.71	28	31	33	27	33	36
		0.700 - 0.60	29	37	39	30	39	42
		0.600 - 0.50	32	41	45	32	43	47
		0.400 - 0.38	34	46	50	34	47	53
		0.370 - 0.00	37	52	59	36	53	61
	0.500 +	1.000 - 0.71	31	39	41	31	40	44
		0.700 - 0.60	33	44	48	33	46	51
		0.600 - 0.50	35	48	54	35	49	56
		0.400 - 0.00	37	53	60	37	53	62
1.51 - 3.00	0.000 - 0.249	1.000 - 0.71	19	20	21	23	26	28
		0.700 - 0.60	22	25	25	26	31	33
		0.600 - 0.50	25	29	30	29	36	39
		0.400 - 0.38	28	33	35	32	41	45
		0.370 - 0.25	31	41	44	36	48	54
		0.240 - 0.00	39	52	58	40	58	66
	0.250 - 0.499	1.000 - 0.71	23	26	27	28	34	38
		0.700 - 0.60	27	32	33	31	39	43
		0.600 - 0.50	30	36	38	34	44	49
		0.400 - 0.38	33	41	44	36	48	55
		0.370 - 0.00	37	49	54	39	55	64
	0.500 +	1.000 - 0.71	28	33	36	32	41	45
		0.700 - 0.60	32	39	41	35	47	53
		0.600 - 0.50	34	44	47	37	51	59
		[illegible]	37	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

OPAQUE WALL Uow

LIGHT WEIGHT WALL — MASS WALL

ILD 0 - 1.50:

Uow (HC<5)	HC RANGE	PCT FEN	INT INS	EXT INS
0.092	HC ≥ 5	22	0.10	0.13
	HC ≥ 10	22	0.11	0.15
	HC ≥ 15	22	0.12	0.18
	HC ≥ 5	83	0.090	0.12
	HC ≥ 10	83	0.10	0.13
	HC ≥ 15	83	0.11	0.14

ILD 1.51 - 3.00:

Uow (HC<5)	HC RANGE	PCT FEN	INT INS	EXT INS
0.092	HC ≥ 5	19	0.10	0.14
	HC ≥ 10	19	0.12	0.18
	HC ≥ 15	19	0.14	0.19
	HC ≥ 5	80	0.090	0.12
	HC ≥ 10	80	0.11	0.14
	HC ≥ 15	80	0.12	0.16

3.01 - 3.50

0.000 - 0.249	1.000 - 0.71	17	18	19	22	28	27
	0.700 - 0.60	20	22	23	26	31	33
	0.599 - 0.50	22	26	26	28	35	38
	0.499 - 0.38	25	30	31	31	39	44
	0.379 - 0.25	30	37	39	35	47	53
	0.249 - 0.00	36	48	53	40	57	67
0.250 - 0.499	1.000 - 0.71	21	23	24	27	33	36
	0.700 - 0.60	24	28	29	30	38	42
	0.599 - 0.50	27	32	34	33	43	48
	0.499 - 0.38	30	37	40	35	47	54
	0.379 - 0.00	36	46	49	38	54	63
0.500 +	1.000 - 0.71	26	30	31	31	40	44
	0.700 - 0.60	29	35	37	34	46	52
	0.599 - 0.50	32	39	42	36	50	58
	0.499 - 0.00	36	44	48	38	54	64

Daylight Sensing Controls

Uow (HC<5)	HC RANGE	PCT FEN	INT INS	EXT INS
0.092	HC ≥ 5	17	0.10	0.15
	HC ≥ 10	17	0.12	0.18
	HC ≥ 15	17	0.14	0.20
	HC ≥ 5	67	0.090	0.13
	HC ≥ 10	67	0.11	0.15
	HC ≥ 15	67	0.12	0.15

	Min R-Value		
WALL BELOW GRADE:	0		
UNHEATED SLAB ON GRADE:	24"	36"	48"
Horizontal	10	14	10
Vertical	7	6	4

	Max Uo
ROOF:	0.052
WALL ADJACENT TO UNCOND SPACE:	0.13
FLOOR OVER UNCOND SPACE:	0.040

ALTERNATE COMPONENT PACKAGES FOR:

HDD60 = 1751 - 3200
CDD65 = 1151 - 2000
VSEW = 600 - 845

Columbia MO
Evansville IN
Lexington KY
Louisville KY
Saint Louis MO

Springfield IL
Topeka KS

TABLE 14-

INTERNAL LOAD DENSITY (ILD) RANGE	PROJECTION FACTOR (PF)	SHADING COEFF RANGE (SCx)	BASE CASE Uof 0.81 to 0.46	BASE CASE Uof 0.45 to 0.39	BASE CASE Uof 0.38 to 0	PERIMETER DAYLIGHTING Uof 0.81 to 0.46	PERIMETER DAYLIGHTING Uof 0.45 to 0	PERIMETER DAYLIGHTING Uof 0.38 to 0 (VLT ≥ SC)
0 - 1.50	0.000 - 0.249	1.000 - 0.71	17	19	19	18	20	21
		0.709 - 0.60	20	23	23	21	25	26
		0.599 - 0.50	22	26	27	24	29	31
		0.499 - 0.38	25	31	32	27	34	36
		0.379 - 0.25	30	39	41	31	42	46
		0.249 - 0.00	37	54	58	38	57	63
	0.250 - 0.499	1.000 - 0.71	21	24	25	22	27	28
		0.709 - 0.60	24	29	30	26	32	34
		0.599 - 0.50	27	34	36	28	37	40
		0.499 - 0.38	30	40	42	31	43	46
		0.379 - 0.00	35	49	52	36	52	57
	0.500 +	1.000 - 0.71	25	31	32	27	33	36
		0.709 - 0.60	29	37	39	30	40	43
		0.599 - 0.50	31	42	45	33	45	49
		0.499 - 0.00	34	48	52	36	52	57
1.51 - 3.00	0.000 - 0.249	1.000 - 0.71	14	15	15	18	21	22
		0.709 - 0.60	17	19	19	22	25	27
		0.599 - 0.50	19	22	22	25	30	32
		0.499 - 0.38	22	26	27	28	35	38
		0.379 - 0.25	27	33	35	33	44	49
		0.249 - 0.00	36	47	50	40	59	66
	0.250 - 0.499	1.000 - 0.71	18	20	20	23	27	29
		0.709 - 0.60	21	24	25	27	33	36
		0.599 - 0.50	24	28	29	30	38	42
		0.499 - 0.38	27	33	35	33	44	49
		0.379 - 0.00	32	42	44	38	54	62
	0.500 +	1.000 - 0.71	22	25	26	27	34	37
		0.709 - 0.60	25	31	33	31	41	46
		0.599 - 0.50	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

OPAQUE WALL Uow

ILD 0 - 1.50:

LIGHT WEIGHT WALL Uow (HC<5)	MASS WALL HC RANGE	PCT FEN	INT INS	EXT INS
0.11	HC ≥ 5	17	0.11	0.15
	HC ≥ 10	17	0.13	0.18
	HC ≥ 15	17	0.15	0.19
	HC ≥ 5	63	0.11	0.14
	HC ≥ 10	63	0.13	0.17
	HC ≥ 15	63	0.14	0.18

ILD 1.51 - 3.00:

LIGHT WEIGHT WALL Uow (HC<5)	MASS WALL HC RANGE	PCT FEN	INT INS	EXT INS
0.11	HC ≥ 5	14	0.11	0.16
	HC ≥ 10	14	0.14	0.20
	HC ≥ 15	14	0.17	0.22
	HC ≥ 5	60	0.11	0.15
	HC ≥ 10	60	0.13	0.18
	HC ≥ 15	60	0.15	0.19

3.01 - 3.50

0.000 - 0.249	1.000 - 0.71	12	13	13	17	19	21
	0.709 - 0.60	14	16	16	20	24	26
	0.599 - 0.50	17	19	19	23	28	31
	0.499 - 0.38	19	22	23	26	33	37
	0.379 - 0.25	24	29	30	31	41	47
	0.249 - 0.00	31	41	43	38	50	60
0.250 - 0.499	1.000 - 0.71	15	17	17	22	25	28
	0.709 - 0.60	18	21	21	25	31	35
	0.599 - 0.50	21	24	25	28	36	40
	0.499 - 0.38	24	29	30	31	41	47
	0.379 - 0.00	29	36	38	35	51	59
0.500 +	1.000 - 0.71	19	21	22	26	32	36
	0.709 - 0.60	22	26	27	29	38	44
	0.599 - 0.50	25	30	32	32	44	51
	0.499 - 0.00	28	36	37	35	50	59

Daylight Sensing Controls

Uow (HC<5)	HC RANGE	PCT FEN	INT INS	EXT INS
0.11	HC ≥ 5	12	0.11	0.18
	HC ≥ 10	12	0.14	0.21
	HC ≥ 15	12	0.17	0.23
	HC ≥ 5	08	0.11	0.15
	HC ≥ 10	08	0.13	0.18
	HC ≥ 15	08	0.15	0.19

	Min R-Value		
WALL BELOW GRADE:	9		
UNHEATED SLAB ON GRADE:	24"	36"	48"
Horizontal	15	13	10
Vertical	7	6	4

	Max Uo
ROOF:	0.050
WALL ADJACENT TO UNCOND SPACE:	0.15
FLOOR OVER UNCOND SPACE:	0.050

ALTERNATE COMPONENT
PACKAGES FOR:

HDD65 = 1751 - 3200
CDD65 = 1151 - 2000
VSEW = > 845

Dodge City KS
Grand Junction CO

TABLE 1.4

INTERNAL LOAD DENSITY (ILD) RANGE	PROJECTION FACTOR (PF)	SHADING COEFF RANGE (SCx)	BASE CASE laf 0.01 to 0.40	BASE CASE 0.45 to 0.39	BASE CASE 0.38 to 0	PERIMETER DAYLIGHTING 0.01 to 0.40	PERIMETER DAYLIGHTING 0.45 to 0	PERIMETER DAYLIGHTING 0.38 to 0 VLT ≥ SC
0 - 1.50	0.000 - 0.249	1.000 - 0.71	15	17	17	18	19	19
		0.709 - 0.60	18	21	21	19	23	24
		0.599 - 0.50	20	24	25	21	26	28
		0.499 - 0.38	22	28	30	23	30	32
		0.379 - 0.25	26	35	38	27	37	41
		0.249 - 0.00	31	47	52	32	49	56
	0.250 - 0.499	1.000 - 0.71	19	22	23	20	24	26
		0.709 - 0.60	22	27	28	23	29	31
		0.599 - 0.50	24	31	33	25	33	36
		0.499 - 0.38	26	36	38	27	38	41
		0.379 - 0.00	30	44	47	31	46	51
	0.500 +	1.000 - 0.71	22	28	29	23	30	32
		0.709 - 0.60	25	34	35	26	36	39
		0.599 - 0.50	28	38	41	28	40	44
		0.499 - 0.00	30	43	47	31	46	51
1.51 - 3.00	0.000 - 0.249	1.000 - 0.71	12	13	14	18	18	20
		0.709 - 0.60	16	17	17	19	22	24
		0.599 - 0.50	17	20	20	21	26	28
		0.499 - 0.38	19	23	24	23	30	34
		0.379 - 0.25	23	29	31	27	37	42
		0.249 - 0.00	30	41	44	33	50	58
	0.250 - 0.499	1.000 - 0.71	18	18	18	20	24	26
		0.709 - 0.60	18	22	22	23	28	32
		0.599 - 0.50	21	25	26	25	33	37
		0.499 - 0.38	23	30	31	27	38	43
		0.379 - 0.00	26	37	39	31	46	53
	0.500 +	1.000 - 0.71	19	23	23	23	30	33
		0.709 - 0.60	22	27	[illegible]	[illegible]	35	40
		0.599 - 0.50	25	32	33	[illegible]	40	[illegible]
		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

OPAQUE WALL Uow

ILD 0 - 1.50:

LIGHT WEIGHT WALL Uow (HC<5)	MASS WALL HC RANGE	PCT FEN	INT INS	EXT INS
0.097	HC ≥ 5	16	0.10	0.14
	HC ≥ 10	16	0.12	0.18
	HC ≥ 15	16	0.13	0.17
	HC ≥ 5	50	0.10	0.13
	HC ≥ 10	50	0.11	0.15
	HC ≥ 15	50	0.13	0.18

ILD 1.51 - 3.00:

LIGHT WEIGHT WALL Uow (HC<5)	MASS WALL HC RANGE	PCT FEN	INT INS	EXT INS
0.097	HC ≥ 5	12	0.10	0.14
	HC ≥ 10	12	0.12	0.18
	HC ≥ 15	12	0.14	0.19
	HC ≥ 5	50	0.10	0.14
	HC ≥ 10	50	0.12	0.18
	HC ≥ 15	50	0.13	0.17

3.01 - 3.50

0.000 - 0.249	1.000 - 0.71	11	11	12	16	17	19
	0.700 - 0.60	13	14	14	17	21	23
	0.599 - 0.50	16	17	17	20	24	27
	0.499 - 0.38	17	20	20	22	28	32
	0.379 - 0.25	21	25	27	26	35	41
	0.249 - 0.00	27	30	30	31	47	50
0.250 - 0.499	1.000 - 0.71	14	15	15	18	22	25
	0.700 - 0.60	16	19	19	21	27	30
	0.599 - 0.50	18	22	22	23	31	35
	0.499 - 0.38	21	26	27	26	35	41
	0.379 - 0.00	25	32	34	29	43	51
0.500 +	1.000 - 0.71	17	19	20	22	28	32
	0.700 - 0.60	19	24	24	25	33	38
	0.599 - 0.50	22	27	28	27	38	44
	0.499 - 0.00	24	32	33	29	43	50

Daylight Sensing Controls

Uow (HC<5)	HC RANGE	PCT FEN	INT INS	EXT INS
0.097	HC ≥ 5	11	0.10	0.15
	HC ≥ 10	11	0.12	0.18
	HC ≥ 15	11	0.15	0.20
	HC ≥ 5	50	0.10	0.14
	HC ≥ 10	50	0.12	0.17
	HC ≥ 15	50	0.14	0.18

	Min R-Value		
WALL BELOW GRADE:	9		
UNHEATED SLAB ON GRADE:	24"	36"	48"
Horizontal	16	13	10
Vertical	7	6	4

	Max Uo
ROOF:	0.063
WALL ADJACENT TO UNCOND SPACE:	0.14
FLOOR OVER UNCOND SPACE:	0.066

ALTERNATE COMPONENT PACKAGES FOR:

HDD65 = 3201 - 4000
CDD65 = 0 - 1150
VSEW = 600 - 845

Albany NY	Grand Rapids MI	Rapid City SD	TABLE 8.4.8
Buffalo NY	Great Falls MT	Rochester NY	
Concord NH	Milwaukee WI	Sheridan WY	
Des Moines IA	Missoula MT	Sioux City IA	
Grand Island NE	Portland ME	Syracuse NY	

INTERNAL LOAD DENSITY (ILD) RANGE	PROJECTION FACTOR (PF)	SHADING COEFF RANGE (SCx)	BASE CASE Uof 0.60 to 0.46	BASE CASE Uof 0.45 to 0.29	BASE CASE Uof 0.28 to 0	PERIMETER DAYLIGHTING N/A	PERIMETER DAYLIGHTING VLT ≥ SC
0 - 1.50	0.000 - 0.249	1.000 - 0.71	20	27	32		
		0.700 - 0.60	21	30	38		
		0.600 - 0.50	21	31	44		
		0.490 - 0.38	21	33	49		
		0.370 - 0.25	22	35	57		
		0.249 - 0.00	22	38	64		
	0.250 - 0.499	1.000 - 0.71	21	31	41		
		0.700 - 0.60	22	34	48		
		0.600 - 0.50	22	35	54		
		0.490 - 0.38	22	38	58		
		0.370 - 0.00	22	38	64		
	0.500 +	1.000 - 0.71	22	35	51		
		0.700 - 0.60	23	38	57		
		0.500 - 0.50	22	37	62		
		0.490 - 0.00	22	37	66		
1.51 - 3.00	0.000 - 0.249	1.000 - 0.71	19	24	27		
		0.700 - 0.60	21	27	33		
		0.600 - 0.50	22	30	38		
		0.490 - 0.38	23	32	43		
		0.370 - 0.25	24	38	52		
		0.249 - 0.00	28	46	64		
	0.250 - 0.499	1.000 - 0.71	22	29	35		
		0.700 - 0.60	23	32	42		
		0.600 - 0.50	24	34	47		
		0.490 - 0.38	25	37	53		
		0.370 - 0.00	28	39	61		
	0.500 +	1.000 - 0.71	23	33	44		
		0.700 - 0.60	24	36	51		
		0.600 - 0.50	25	38	[illegible]		
		[illegible]	[illegible]	[illegible]	[illegible]		

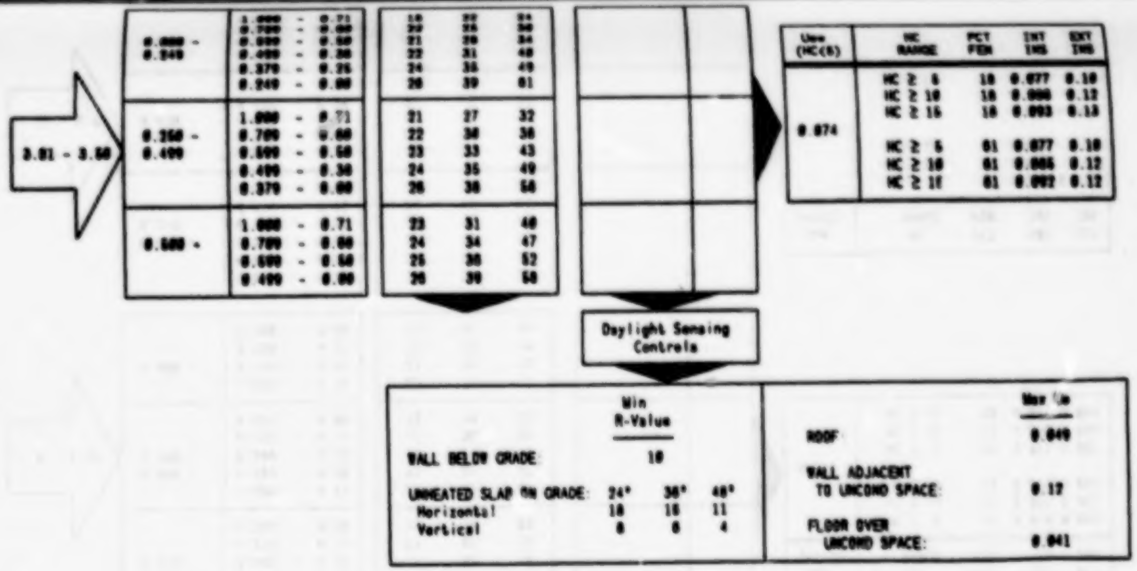
OPAQUE WALL Uow

ILD 0 - 1.50:

LIGHT WEIGHT WALL Uow (HC(5))	MASS WALL HC RANGE	PCT FEN	INT INS	EXT INS
0.074	HC ≥ 5	20	0.079	0.090
	HC ≥ 10	20	0.082	0.10
	HC ≥ 15	20	0.087	0.11
	HC ≥ 5	65	0.077	0.090
	HC ≥ 10	65	0.084	0.11
	HC ≥ 15	65	0.089	0.11

ILD 1.51 - 3.00:

LIGHT WEIGHT WALL Uow (HC(5))	MASS WALL HC RANGE	PCT FEN	INT INS	EXT INS
0.074	HC ≥ 5	10	0.077	0.10
	HC ≥ 10	10	0.084	0.12
	HC ≥ 15	10	0.091	0.12
	HC ≥ 5	64	0.077	0.10
	HC ≥ 10	64	0.084	0.11
	HC ≥ 15	64	0.091	0.12



0.000 - 0.249	1.000 - 0.71	19	22	24
	0.700 - 0.60	20	24	30
	0.600 - 0.50	21	29	34
	0.499 - 0.38	22	31	40
	0.379 - 0.25	24	35	49
	0.249 - 0.00	28	39	61
0.250 - 0.499	1.000 - 0.71	21	27	32
	0.700 - 0.60	22	30	38
	0.600 - 0.50	23	33	43
	0.499 - 0.38	24	35	49
	0.379 - 0.00	26	38	56
0.500 +	1.000 - 0.71	23	31	40
	0.700 - 0.60	24	34	47
	0.600 - 0.50	25	36	52
	0.499 - 0.00	26	39	58

Uow (HC(6))	HC RANGE	PCT FEN	INT INS	EXT INS
0.074	HC ≥ 6	10	0.077	0.10
	HC ≥ 10	10	0.088	0.12
	HC ≥ 15	10	0.093	0.13
	HC ≥ 6	01	0.077	0.10
	HC ≥ 10	01	0.085	0.12
	HC ≥ 15	01	0.092	0.12

Daylight Sensing Controls

	Min R-Value		
WALL BELOW GRADE:	10		
UNHEATED SLAB ON GRADE:	24"	36"	48"
Horizontal	10	10	11
Vertical	6	6	4

	Max Uo
ROOF:	0.049
WALL ADJACENT TO UNCOND SPACE:	0.17
FLOOR OVER UNCOND SPACE:	0.041

ALTERNATE COMPONENT PACKAGES FOR:

HDD65 = 4001 - 5000
CDD65 = 0 - 1150
VSEB = 500 - 845

Alpena MI	Greenbay WI	Miles City MT	TABLE 8.4-8
Bangor ME	Huron SD	Minneapolis MN	
Burlington VT	Madison WI	Pierre SD	
Cutbank MT	Mason City IA	Rochester NY	
Eau Claire WI	Massena NY	Sioux Falls SD	

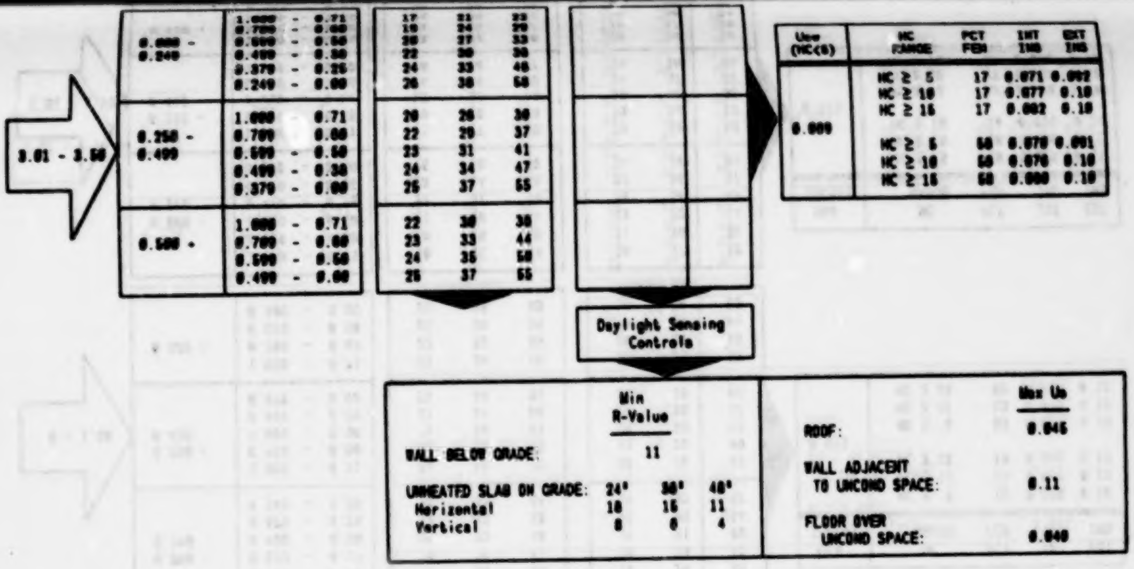
INTERNAL LOAD DENSITY (ILD) RANGE	PROJECTION FACTOR (PF)	SHADING COEFF RANGE (SCx)	BASE CASE Uof 0.60 to 0.46	BASE CASE Uof 0.45 to 0.29	BASE CASE Uof 0.28 to 0	PERIMETER DAYLIGHTING N/A	VLT ≥ SC
0 - 1.50	0.000 - 0.249	1.000 - 0.71	19	26	31		
		0.700 - 0.60	21	29	37		
		0.600 - 0.50	21	31	42		
		0.499 - 0.38	22	33	48		
		0.379 - 0.25	22	35	55		
		0.249 - 0.00	22	36	62		
	0.250 - 0.499	1.000 - 0.71	21	31	40		
		0.700 - 0.60	22	33	47		
		0.600 - 0.50	22	34	52		
		0.499 - 0.38	22	35	58		
		0.379 - 0.00	23	36	62		
	0.500 +	1.000 - 0.71	22	34	49		
		0.700 - 0.60	23	35	55		
		0.600 - 0.50	23	36	57		
		0.499 - 0.00	23	37	63		

OPAQUE WALL Uow

LIGHT WEIGHT WALL Uow (HC<5)	MASS WALL HC RANGE	PCT FEN	INT INS	EXT INS
0.089	HC ≥ 5	19	0.070	0.086
	HC ≥ 10	19	0.074	0.094
	HC ≥ 15	19	0.078	0.098
	HC ≥ 5	63	0.071	0.087
	HC ≥ 10	63	0.075	0.090
	HC ≥ 15	63	0.079	0.099

INTERNAL LOAD DENSITY (ILD) RANGE	PROJECTION FACTOR (PF)	SHADING COEFF RANGE (SCx)	BASE CASE Uof 0.60 to 0.46	BASE CASE Uof 0.45 to 0.29	BASE CASE Uof 0.28 to 0	PERIMETER DAYLIGHTING N/A	VLT ≥ SC
1.51 - 3.00	0.000 - 0.249	1.000 - 0.71	18	23	26		
		0.700 - 0.60	20	26	31		
		0.600 - 0.50	21	29	36		
		0.499 - 0.38	22	31	42		
		0.379 - 0.26	24	35	50		
		0.249 - 0.00	25	38	61		
	0.250 - 0.499	1.000 - 0.71	21	28	33		
		0.700 - 0.60	22	31	40		
		0.600 - 0.50	23	33	45		
		0.499 - 0.38	24	35	50		
		0.379 - 0.00	26	38	58		
	0.500 +	1.000 - 0.71	23	32	41		
		0.700 - 0.60	24	36	48		
		0.600 - 0.50	25	38	53		
		0.499 - 0.00	26	[illegible]	[illegible]		

LIGHT WEIGHT WALL Uow (HC<5)	MASS WALL HC RANGE	PCT FEN	INT INS	EXT INS
0.089	HC ≥ 5	18	0.071	0.090
	HC ≥ 10	18	0.076	0.10
	HC ≥ 15	18	0.080	0.10
	HC ≥ 5	61	0.070	0.090
	HC ≥ 10	61	0.075	0.10
	HC ≥ 15	61	0.079	0.10



0.000 - 0.249	1.000 - 0.71 0.700 - 0.60 0.599 - 0.50 0.499 - 0.38 0.379 - 0.25 0.249 - 0.00	17 19 20 22 24 26	21 24 27 30 33 38	23 29 33 38 46 58
0.250 - 0.499	1.000 - 0.71 0.700 - 0.60 0.599 - 0.50 0.499 - 0.38 0.379 - 0.00	20 22 23 24 25	26 29 31 34 37	30 37 41 47 55
0.500 +	1.000 - 0.71 0.700 - 0.60 0.599 - 0.50 0.499 - 0.00	22 23 24 25	30 33 35 37	38 44 50 55

Uow (HC<5)	HC RANGE	PCT FEN	INT INS	EXT INS
0.099	HC ≥ 5	17	0.071	0.092
	HC ≥ 10	17	0.077	0.10
	HC ≥ 15	17	0.082	0.10
	HC ≥ 5	50	0.070	0.081
	HC ≥ 10	50	0.076	0.10
	HC ≥ 15	50	0.080	0.10

	Min R-Value		
WALL BELOW GRADE:	11		
UNHEATED SLAB ON GRADE:	24"	36"	48"
Horizontal	10	15	11
Vertical	8	6	4

	Max Uo
ROOF:	0.046
WALL ADJACENT TO UNCOND SPACE:	0.11
FLOOR OVER UNCOND SPACE:	0.040

ALTERNATE COMPONENT
PACKAGES FOR:

HDD65 = 3201 - 4000
CDD65 = 0 - 1150
VSEW = > 845

Casper WY
Cheyenne WY
Elko NV
Ely NV
North Platte NE

Pocatello ID
Scottsbluff NE

TABLE

INTERNAL LOAD DENSITY (ILD) RANGE	PROJECTION FACTOR (PF)	SHADING COEFF RANGE (SCx)	BASE CASE Uof 0.60 to 0.40	BASE CASE Uof 0.45 to 0.20	BASE CASE Uof 0.20 to 0	PERIMETER DAYLIGHTING Uof 0.60 to 0.40	PERIMETER DAYLIGHTING Uof 0.45 to 0	PERIMETER DAYLIGHTING Uof 0.20 to 0 VLT ≥ SC
0 - 1.50	0.000 - 0.249	1.000 - 0.71	19	20	30	19	20	32
		0.709 - 0.60	20	20	30	19	29	38
		0.599 - 0.50	20	30	41	19	30	43
		0.499 - 0.38	20	32	48	19	31	48
		0.379 - 0.25	20	33	53	19	32	54
		0.249 - 0.00	20	33	60	19	32	57
	0.250 - 0.499	1.000 - 0.71	21	31	39	20	31	42
		0.709 - 0.60	21	33	48	20	32	49
		0.599 - 0.50	21	34	51	20	33	53
		0.499 - 0.38	21	34	60	20	33	57
		0.379 - 0.00	21	34	61	20	33	60
	0.500 +	1.000 - 0.71	22	34	49	21	34	52
		0.709 - 0.60	22	35	55	20	34	58
		0.599 - 0.50	21	36	60	20	34	61
		0.499 - 0.00	21	36	63	20	34	62
1.51 - 3.00	0.000 - 0.249	1.000 - 0.71	18	22	24	20	27	32
		0.709 - 0.60	20	25	30	21	30	38
		0.599 - 0.50	21	28	34	22	32	44
		0.499 - 0.38	22	31	40	23	34	49
		0.379 - 0.25	23	34	48	23	36	57
		0.249 - 0.00	25	36	50	24	36	64
	0.250 - 0.499	1.000 - 0.71	21	27	32	22	32	42
		0.709 - 0.60	22	30	38	23	34	49
		0.599 - 0.50	23	33	43	23	36	55
		0.499 - 0.38	24	35	49	24	37	60
		0.379 - 0.00	25	36	57	24	38	66
	0.500 +	1.000 - 0.71	23	32	48	23	30	52
		0.709 - 0.60	24	35	47	24	37	58

OPAQUE WALL Uow

LIGHT WEIGHT WALL | MASS WALL

ILD 0 - 1.50:

Uow (HC<5)	HC RANGE	PCT FEN	INT INS	EXT INS
0.073	HC ≥ 5	19	0.070	0.10
	HC ≥ 10	19	0.085	0.12
	HC ≥ 15	19	0.092	0.12
	HC ≥ 5	63	0.070	0.10
	HC ≥ 10	63	0.080	0.12
	HC ≥ 15	63	0.096	0.13

ILD 1.51 - 3.00:

Uow (HC<5)	HC RANGE	PCT FEN	INT INS	EXT INS
0.073	HC ≥ 5	18	0.077	0.11
	HC ≥ 10	18	0.088	0.13
	HC ≥ 15	18	0.098	0.14
	HC ≥ 5	67	0.070	0.10
	HC ≥ 10	67	0.087	0.12
	HC ≥ 15	67	0.090	0.13

3.01 - 3.50

0.000 - 0.249	1.000 - 0.71 0.709 - 0.60 0.599 - 0.50 0.499 - 0.38 0.379 - 0.26 0.249 - 0.00	18 19 20 21 23 25	19 23 25 28 32 36	21 26 30 36 43 55	20 21 22 23 24 25	28 30 32 34 36 38	31 36 43 49 57 64
0.250 - 0.499	1.000 - 0.71 0.709 - 0.60 0.599 - 0.50 0.499 - 0.38 0.379 - 0.00	19 21 22 23 24	24 28 30 33 36	28 34 39 44 52	22 23 23 24 25	31 34 35 37 38	41 48 54 59 65
0.500 -	1.000 - 0.71 0.709 - 0.60 0.599 - 0.50 0.499 - 0.00	21 23 24 24	29 32 34 36	36 42 47 53	23 24 24 25	35 37 38 39	51 58 63 66

Uow (HC<5)	HC RANGE	PCT FEN	INT INS	EXT INS
0.073	HC ≥ 5	10	0.077	0.11
	HC ≥ 10	10	0.080	0.14
	HC ≥ 15	10	0.10	0.16
	HC ≥ 5	60	0.077	0.10
	HC ≥ 10	60	0.086	0.12
	HC ≥ 15	60	0.095	0.13

Daylight Sensing Controls

	Min R-Value		
WALL BELOW GRADE:	10		
UNHEATED SLAB ON GRADE:	24"	36"	48"
Horizontal	18	15	11
Vertical	6	6	4

	Max Uo
ROOF:	0.040
WALL ADJACENT TO UNCOND SPACE:	0.12
FLOOR OVER UNCOND SPACE:	0.042

ALTERNATE COMPONENT
PACKAGES FOR:

Bryce UT
Eagle CO
Rock Springs WY

TABLE 1.4

HDD65 = 4001 - 5000
CDD65 = 0 - 1150
VSER = > 845

INTERNAL LOAD DENSITY (ILD) RANGE	PROJECTION FACTOR (PF)	SHADING COEFF RANGE (SCx)	BASE CASE Uof 0.60 to 0.46	BASE CASE Uof 0.45 to 0.29	BASE CASE Uof 0.28 to 0	PERIMETER DAYLIGHTING N/A	PERIMETER DAYLIGHTING VLT ≥ SC
0 - 1.50	0.000 - 0.249	1.000 - 0.71	16	30	40		
		0.709 - 0.60	14	29	47		
		0.599 - 0.50	13	27	51		
		0.499 - 0.38	11	24	53		
		0.379 - 0.25	10	20	51		
		0.249 - 0.00	6	16	40		
	0.250 - 0.499	1.000 - 0.71	15	31	51		
		0.709 - 0.60	13	20	56		
		0.599 - 0.50	11	25	57		
		0.499 - 0.38	10	22	56		
		0.379 - 0.00	9	18	40		
	0.500 +	1.000 - 0.71	13	30	59		
		0.709 - 0.60	11	25	60		
		0.599 - 0.50	10	22	58		
		0.499 - 0.00	9	19	53		
1.51 - 3.00	0.000 - 0.249	1.000 - 0.71	17	28	32		
		0.709 - 0.60	17	27	38		
		0.599 - 0.50	17	28	42		
		0.499 - 0.38	17	28	46		
		0.379 - 0.25	16	27	49		
		0.249 - 0.00	15	26	49		
	0.250 - 0.499	1.000 - 0.71	18	29	41		
		0.709 - 0.60	17	29	46		
		0.599 - 0.50	17	29	49		
		0.499 - 0.38	16	28	51		
		0.379 - 0.00	16	27	52		
	0.500 +	1.000 - 0.71	18	30	49		
		0.709 - 0.60	17	30	52		
		0.599 - 0.50	17	29	54		
		[illegible]	[illegible]	[illegible]	[illegible]		

OPAQUE WALL Uow

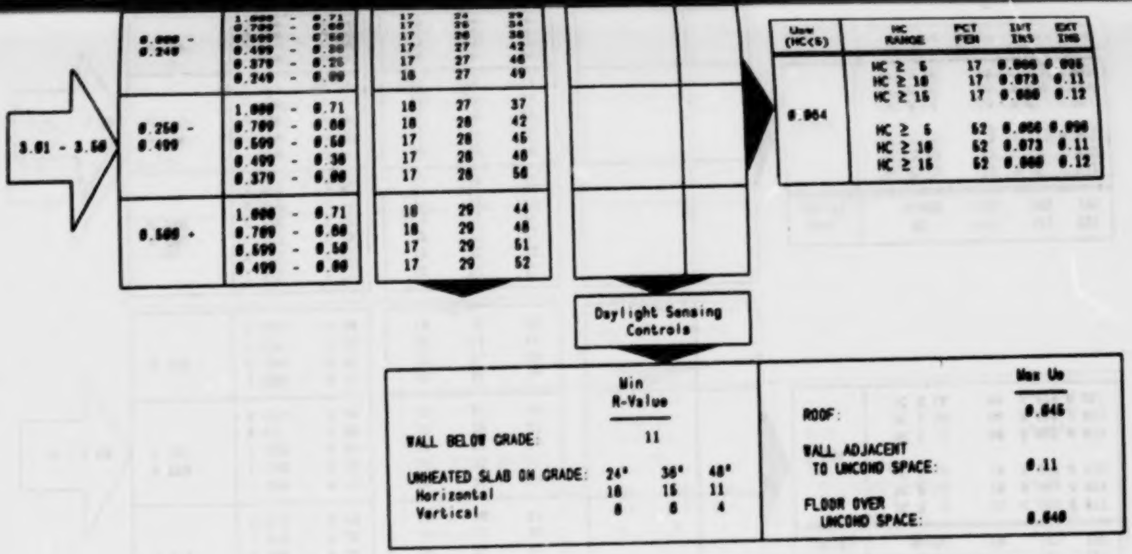
LIGHT WEIGHT WALL | MASS WALL

ILD 0 - 1.50:

Uow (HC<5)	HC RANGE	PCT FEN	INT INS	EXT INS
0.064	HC ≥ 5	10	0.065	0.080
	HC ≥ 10	10	0.070	0.10
	HC ≥ 15	10	0.075	0.10
	HC ≥ 5	60	0.060	0.10
	HC ≥ 10	60	0.074	0.12
	HC ≥ 15	60	0.083	0.13

ILD 1.51 - 3.00:

Uow (HC<5)	HC RANGE	PCT FEN	INT INS	EXT INS
0.064	HC ≥ 5	17	0.060	0.093
	HC ≥ 10	17	0.072	0.11
	HC ≥ 15	17	0.079	0.11
	HC ≥ 5	54	0.058	0.094
	HC ≥ 10	54	0.073	0.11
	HC ≥ 15	54	0.080	0.12



0.000 - 0.249	1.000 - 0.71	17	24	29
	0.700 - 0.60	17	26	34
	0.599 - 0.50	17	26	38
	0.499 - 0.38	17	27	42
	0.379 - 0.25	17	27	46
	0.249 - 0.00	18	27	49
0.250 - 0.499	1.000 - 0.71	18	27	37
	0.700 - 0.60	18	28	42
	0.599 - 0.50	17	28	45
	0.499 - 0.38	17	28	48
	0.379 - 0.00	17	28	50
0.500 +	1.000 - 0.71	18	29	44
	0.700 - 0.60	18	29	48
	0.599 - 0.50	17	29	51
	0.499 - 0.00	17	29	52

Uow (HC<5)	HC RANGE	PCT FEN	INT INS	EXT INS
0.064	HC ≥ 5	17	0.060	0.095
	HC ≥ 10	17	0.073	0.11
	HC ≥ 15	17	0.080	0.12
	HC ≥ 5	52	0.056	0.090
	HC ≥ 10	52	0.073	0.11
	HC ≥ 15	52	0.080	0.12

Daylight Sensing Controls

	Min R-Value		
WALL BELOW GRADE:	11		
UNHEATED SLAB ON GRADE:	24"	36"	48"
Horizontal	18	15	11
Vertical	8	6	4

	Max Uo
ROOF:	0.045
WALL ADJACENT TO UNCOND SPACE:	0.11
FLOOR OVER UNCOND SPACE:	0.040

ALTERNATE COMPONENT
PACKAGES FOR:

HDD50 = 6001 - 6500
CDD65 = 0 - 1150
VSEW = 500 - 845

Bismarck ND
Caribou ME
Duluth MN
Fargo ND
Glasgow MT

International Falls MN
Minot ND
Sault Sainte Marie MI

TABLE 8.4

INTERNAL LOAD DENSITY (ILD) RANGE	PROJECTION FACTOR (PF)	SHADING COEFF RANGE (SCx)	BASE CASE Uof 0.60 to 0.46	BASE CASE Uof 0.45 to 0.21	BASE CASE Uof 0.20 to 0	PERIMETER DAYLIGHTING N/A	PERIMETER DAYLIGHTING VLT ≥ SC
0 - 1.50	0.000 - 0.249	1.000 - 0.71	19	28	37		
		0.709 - 0.60	19	30	43		
		0.599 - 0.50	19	31	47		
		0.499 - 0.38	19	31	51		
		0.379 - 0.25	18	31	55		
		0.249 - 0.00	18	30	57		
	0.250 - 0.499	1.000 - 0.71	20	31	40		
		0.709 - 0.60	19	32	51		
		0.599 - 0.50	19	32	55		
		0.499 - 0.38	19	32	57		
		0.379 - 0.00	18	31	59		
	0.500 -	1.000 - 0.71	20	33	53		
		0.709 - 0.60	19	33	58		
		0.599 - 0.50	19	32	59		
		0.499 - 0.00	19	32	60		
1.51 - 3.00	0.000 - 0.249	1.000 - 0.71	18	25	31		
		0.709 - 0.60	19	28	38		
		0.599 - 0.50	20	29	41		
		0.499 - 0.38	20	31	48		
		0.379 - 0.25	21	33	52		
		0.249 - 0.00	21	34	58		
	0.250 - 0.499	1.000 - 0.71	20	29	39		
		0.709 - 0.60	21	31	45		
		0.599 - 0.50	21	32	49		
		0.499 - 0.38	21	33	53		
		0.379 - 0.00	21	34	58		
	0.500 -	1.000 - 0.71	21	32	48		
		0.709 - 0.60	21	33	52		
		0.599 - 0.50	21	34	55		
		[illegible]	[illegible]	[illegible]	[illegible]		

OPAQUE WALL Uow

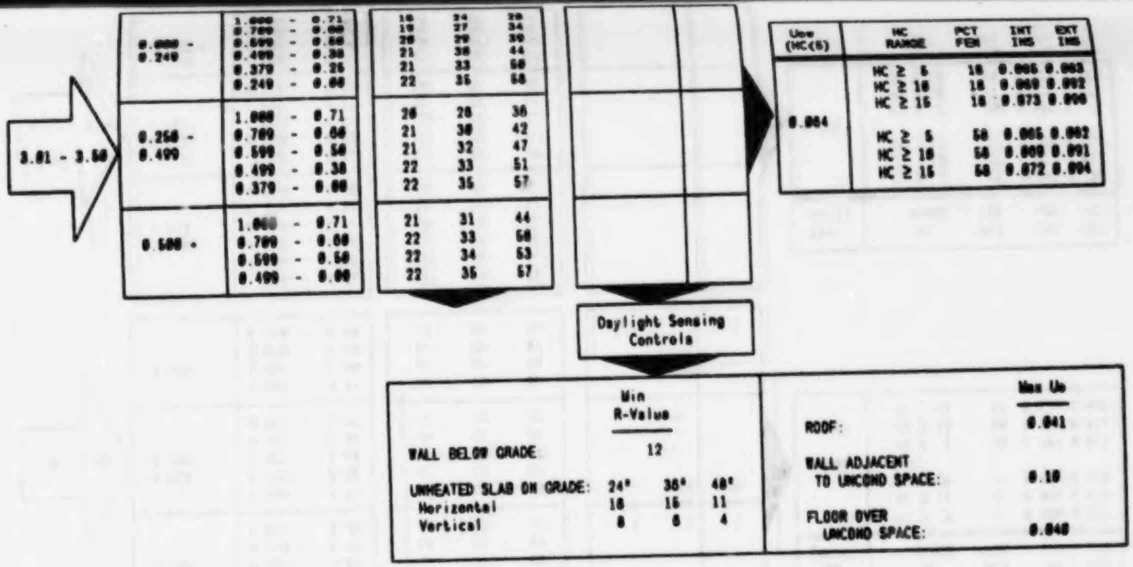
LIGHT WEIGHT WALL | MASS WALL

ILD 0 - 1.50:

Uow (HC<5)	HC RANGE	PCT FEN	INT INS	EXT INS
0.084	HC ≥ 5	10	0.085	0.077
	HC ≥ 10	10	0.080	0.083
	HC ≥ 15	10	0.079	0.086
	HC ≥ 5	60	0.085	0.079
	HC ≥ 10	60	0.080	0.085
	HC ≥ 15	60	0.079	0.087

ILD 1.51 - 3.00:

Uow (HC<5)	HC RANGE	PCT FEN	INT INS	EXT INS
0.084	HC ≥ 5	10	0.085	0.081
	HC ≥ 10	10	0.080	0.090
	HC ≥ 15	10	0.072	0.093
	HC ≥ 5	50	0.085	0.081
	HC ≥ 10	50	0.080	0.089
	HC ≥ 15	50	0.072	0.092



0.000 - 0.249	1.000 - 0.71	18	24	29
	0.700 - 0.60	19	27	34
	0.599 - 0.50	20	29	39
	0.499 - 0.30	21	30	44
	0.379 - 0.25	21	33	50
	0.249 - 0.00	22	35	58
0.250 - 0.499	1.000 - 0.71	20	28	36
	0.700 - 0.60	21	30	42
	0.599 - 0.50	21	32	47
	0.499 - 0.30	22	33	51
	0.379 - 0.00	22	35	57
0.500 +	1.000 - 0.71	21	31	44
	0.700 - 0.60	22	33	50
	0.599 - 0.50	22	34	53
	0.499 - 0.00	22	35	57

Uow (HC<5)	HC RANGE	PCT FEN	INT INS	EXT INS
0.064	HC ≥ 5	10	0.066 0.063	
	HC ≥ 10	10	0.069	0.092
	HC ≥ 15	10	0.073	0.090
	HC ≥ 5	50	0.065	0.082
	HC ≥ 10	50	0.069	0.091
	HC ≥ 15	50	0.072	0.094

	Min R-Value		
WALL BELOW GRADE:	12		
UNHEATED SLAB ON GRADE:	24"	36"	48"
Horizontal	18	15	11
Vertical	8	6	4

	Max Uo
ROOF:	0.041
WALL ADJACENT TO UNCOND SPACE:	0.10
FLOOR OVER UNCOND SPACE:	0.040

ALTERNATE COMPONENT
PACKAGES FOR:

HDD65 = 1 - 6500
CDD65 = < 100
VSEW = < 500

Adak AK
Anchorage AK
Annette AK
Juneau AK
Kodiak AK
Yakutat AK

TABLE

INTERNAL LOAD DENSITY (TLD) RANGE	PROJECTION FACTOR (PF)	SHADING COEFF RANGE (SCx)	BASE CASE Uof 0.60 to 0.46	BASE CASE Uof 0.45 to 0.29	BASE CASE Uof 0.28 to 0	PERIMETER DAYLIGHTING N/A	PERIMETER DAYLIGHTING VLT ≥ SC
0 - 1.50	0.000 - 0.249	1.000 - 0.71	17	29	45		
		0.709 - 0.60	18	29	50		
		0.599 - 0.50	15	28	53		
		0.499 - 0.38	14	27	55		
		0.379 - 0.25	13	25	53		
		0.249 - 0.00	12	22	48		
	0.250 - 0.499	1.000 - 0.71	18	30	53		
		0.709 - 0.60	15	28	56		
		0.599 - 0.50	14	27	57		
		0.499 - 0.38	14	26	56		
		0.379 - 0.00	13	23	52		
	0.500 +	1.000 - 0.71	15	29	58		
		0.709 - 0.00	14	27	58		
		0.599 - 0.50	14	26	57		
		0.499 - 0.00	13	24	54		
1.51 - 3.00	0.000 - 0.249	1.000 - 0.71	17	27	39		
		0.709 - 0.60	17	28	44		
		0.599 - 0.50	17	28	48		
		0.499 - 0.38	18	28	50		
		0.379 - 0.25	18	27	52		
		0.249 - 0.00	15	26	51		
	0.250 - 0.499	1.000 - 0.71	17	29	47		
		0.709 - 0.60	17	29	51		
		0.599 - 0.50	18	28	53		
		0.499 - 0.38	16	28	54		
		0.379 - 0.00	15	27	53		
	0.500 +	1.000 - 0.71	17	29	53		
		0.709 - 0.00	18	29	[illegible]		
		[illegible]	18	28	[illegible]		
		[illegible]	[illegible]	27	[illegible]		

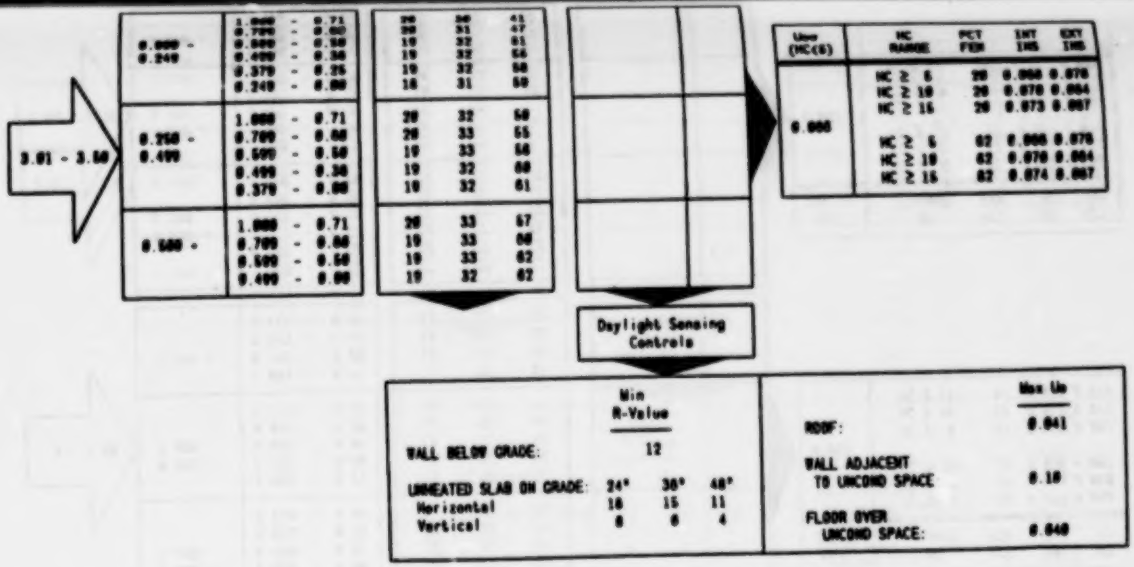
OPAQUE WALL Uow — LIGHT WEIGHT WALL / MASS WALL

TLD 0 - 1.50:

Uow (HC<5)	HC RANGE	PCT FEN	INT INS	EXT INS
0.000	HC ≥ 5	17	0.066	0.071
	HC ≥ 10	17	0.069	0.075
	HC ≥ 15	17	0.071	0.079
	HC ≥ 5	50	0.067	0.073
	HC ≥ 10	50	0.069	0.078
	HC ≥ 15	50	0.072	0.080

TLD 1.51 - 3.00:

Uow (HC<5)	HC RANGE	PCT FEN	INT INS	EXT INS
0.000	HC ≥ 5	17	0.066	0.074
	HC ≥ 10	17	0.070	0.082
	HC ≥ 15	17	0.073	0.084
	HC ≥ 5	66	0.066	0.075
	HC ≥ 10	66	0.070	0.082
	HC ≥ 15	66	0.073	0.084



0.000 - 0.249	1.000 - 0.71	20	30	41
	0.709 - 0.60	20	31	47
	0.600 - 0.50	19	32	51
	0.499 - 0.38	19	32	56
	0.379 - 0.25	19	32	58
	0.249 - 0.00	18	31	59
0.250 - 0.499	1.000 - 0.71	20	32	50
	0.709 - 0.60	20	33	55
	0.599 - 0.50	19	33	56
	0.499 - 0.38	19	32	60
	0.379 - 0.00	18	32	61
0.500 -	1.000 - 0.71	20	33	57
	0.709 - 0.60	19	33	60
	0.599 - 0.50	19	33	62
	0.499 - 0.00	19	32	62

Uow (HC(6))	HC RANGE	PCT FEN	INT INS	EXT INS
0.080	HC ≥ 6	20	0.068	0.078
	HC ≥ 10	20	0.070	0.084
	HC ≥ 15	20	0.073	0.087
	HC ≥ 6	62	0.066	0.078
	HC ≥ 10	62	0.070	0.084
	HC ≥ 15	62	0.074	0.087

Daylight Sensing Controls

	Min R-Value		
WALL BELOW GRADE:	12		
UNHEATED SLAB ON GRADE:	24"	30"	48"
Horizontal	18	15	11
Vertical	8	6	4

	Max Uo
ROOF:	0.041
WALL ADJACENT TO UNCOND SPACE	0.10
FLOOR OVER UNCOND SPACE:	0.040

ALTERNATE COMPONENT PACKAGES FOR:

HDD65 = > 6500
CDD65 = < 100
VSEW = < 500

Bethel AK
Big Delta AK
Fairbanks AK
Gulkana AK
King Salmon AK

McGrath AK
Nome AK
Summit AK

TABLE 8.4

INTERNAL LOAD DENSITY (ILD) RANGE	PROJECTION FACTOR (PF)	SHADING COEFF RANGE (SCx)	BASE CASE Uof 0.80 to 0.46	BASE CASE Uof 0.45 to 0.20	BASE CASE Uof 0.20 to 0	PERIMETER DAYLIGHTING N/A	PERIMETER DAYLIGHTING VLT ≥ SC
0 - 1.50	0.000 - 0.249	1.000 - 0.71	16	30	49		
		0.700 - 0.60	15	29	53		
		0.599 - 0.50	14	27	54		
		0.499 - 0.38	13	25	54		
		0.379 - 0.25	12	23	50		
		0.249 - 0.00	11	20	43		
	0.250 - 0.499	1.000 - 0.71	15	29	55		
		0.700 - 0.60	14	27	56		
		0.599 - 0.50	13	25	55		
		0.499 - 0.38	12	23	52		
		0.379 - 0.00	12	21	47		
	0.500 +	1.000 - 0.71	14	27	57		
		0.700 - 0.60	13	25	55		
		0.599 - 0.50	12	23	52		
		0.499 - 0.00	12	22	48		
1.51 - 3.00	0.000 - 0.249	1.000 - 0.71	17	27	41		
		0.700 - 0.60	16	27	46		
		0.599 - 0.50	16	27	48		
		0.499 - 0.38	15	26	49		
		0.379 - 0.25	15	25	49		
		0.249 - 0.00	14	24	46		
	0.250 - 0.499	1.000 - 0.71	16	28	48		
		0.700 - 0.60	16	27	50		
		0.599 - 0.50	15	26	51		
		0.499 - 0.38	15	26	50		
		0.379 - 0.00	14	24	48		
	0.500 +	1.000 - 0.71	16	27	51		
		0.700 - 0.60	15	26	52		
		0.599 - 0.50	15	26	51		

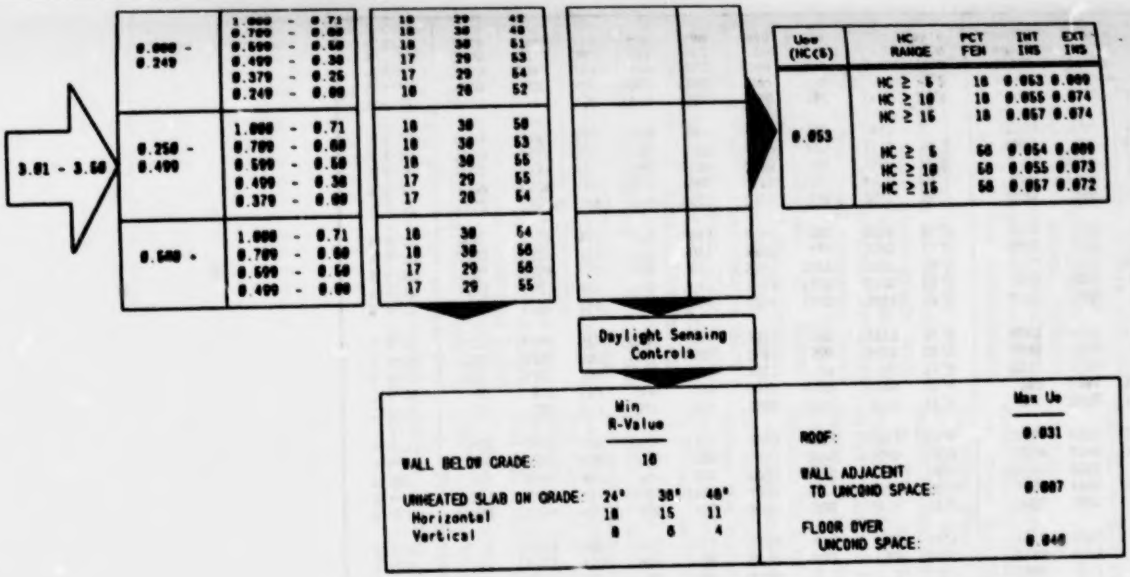
OPAQUE WALL Uow

ILD 0 - 1.50:

LIGHT WEIGHT WALL Uow (HC<5)	MASS WALL HC RANGE	PCT FEN	INT INS	EXT INS
0.053	HC ≥ 5	16	0.053	0.065
	HC ≥ 10	16	0.056	0.060
	HC ≥ 15	16	0.056	0.057
	HC ≥ 5	57	0.053	0.080
	HC ≥ 10	57	0.058	0.074
	HC ≥ 15	57	0.058	0.074

ILD 1.51 - 3.00:

LIGHT WEIGHT WALL Uow (HC<5)	MASS WALL HC RANGE	PCT FEN	INT INS	EXT INS
0.053	HC ≥ 5	17	0.053	0.080
	HC ≥ 10	17	0.056	0.072
	HC ≥ 15	17	0.057	0.072
	HC ≥ 5	52	0.053	0.080
	HC ≥ 10	52	0.058	0.074
	HC ≥ 15	52	0.057	0.073



0.000 - 0.249	1.000 - 0.71	10	29	42
	0.709 - 0.60	10	30	48
	0.599 - 0.50	10	30	51
	0.499 - 0.38	17	29	53
	0.379 - 0.26	17	29	54
	0.249 - 0.00	10	28	52
0.250 - 0.499	1.000 - 0.71	10	30	50
	0.709 - 0.60	10	30	53
	0.599 - 0.50	10	30	56
	0.499 - 0.38	17	29	55
	0.379 - 0.00	17	28	54
0.500 +	1.000 - 0.71	10	30	54
	0.709 - 0.60	10	30	56
	0.599 - 0.50	17	29	58
	0.499 - 0.00	17	29	55

Uow (HC<5)	HC RANGE	PCT FEN	INT INS	EXT INS
0.053	HC ≥ 5	10	0.053	0.000
	HC ≥ 10	10	0.055	0.074
	HC ≥ 15	10	0.057	0.074
	HC ≥ 5	50	0.054	0.000
	HC ≥ 10	50	0.055	0.073
	HC ≥ 15	50	0.057	0.072

	Min R-Value		
WALL BELOW GRADE:	10		
UNHEATED SLAB ON GRADE:	24"	36"	48"
Horizontal	10	15	11
Vertical	8	6	4

	Max Uo
ROOF:	0.031
WALL ADJACENT TO UNCOND SPACE:	0.087
FLOOR OVER UNCOND SPACE:	0.040

Table 5.4-32
Climate Data Used for ACP Tables

ACP TABLE	Exterior Facades									Roof			Wall, Floor, Slab
	HDD50	HDD65	VSN	VSEW	VSS	CDD50	CDD65	CDH80	DR	HDD65	CDD65	CDH80	HDD65
5.4-2	0	0	557	817	805	8494	3019	1112	11.0	0	4150	4537	0
5.4-3	0	0	609	1002	977	10869	5394	10167	9.7	0	6160	1621[illegible]	0
5.4-4	582	5020	407	724	926	1038	1	0	8.9	5020	1	0	5020
5.4-5	157	2922	453	909	1102	2792	82	23	16.4	3238	73	204	3238
5.4-6	3	1694	482	962	1146	4456	472	136	14.1	1577	834	2391	1577
5.4-7	569	2556	461	826	996	5277	1788	3614	15.2	2882	1825	6272	3220
5.4-8	381	2753	444	987	1185	4274	1171	7315	34.6	2884	1930	14404	2884
5.4-9	435	2194	467	796	925	5722	2005	5249	16.4	3091	2055	8430	3091
5.4-10	699	2708	476	862	996	5844	2378	12065	20.2	3049	2299	14487	3049
5.4-11	409	2444	468	1091	1312	6222	2782	26739	27.4	2444	2782	26739	2573
5.4-12	33	532	511	881	974	8288	3312	9757	17.1	874	3652	15512	889
5.4-13	65	842	532	900	936	8827	4130	25225	21.4	782	4186	37892	1382
5.4-14	1080	5226	350	588	782	1357	29	145	12.3	5550	79	466	5550
5.4-15	1531	4893	405	814	1005	2681	568	4081	32.9	4893	568	4081	4893
5.4-16	1477	4462	473	1090	1334	3385	895	3973	24.0	4802	1041	11568	4802
5.4-17	1261	3760	449	810	994	4274	1298	3642	17.4	4192	1183	3306	4192
5.4-18	1633	4423	469	1105	1361	3942	1257	5705	25.3	3825	1834	8878	4423
5.4-19	1034	3259	460	806	935	5319	2069	7807	19.2	3732	2072	10065	3732
5.4-20	2323	5877	373	790	1091	2370	449	3285	31.2	6665	228	2390	6665
5.4-21	2983	6727	363	758	1064	2094	363	1595	25.3	6514	698	1794	6727
5.4-22	1947	5583	419	909	1153	2395	556	2073	16.2	6471	486	6366	6471
5.4-23	1839	6509	446	812	982	4115	1311	4170	20.4	5201	1388	5212	5448
5.4-24	2280	5131	450	942	1196	4008	1384	7186	26.0	5701	1221	6147	5701
5.4-25	3492	7560	363	704	957	1629	221	1513	30.8	7817	328	1771	7817
5.4-26	4583	8397	380	708	942	2026	365	913	20.9	8351	774	3739	8941
5.4-27	3683	7666	432	1014	1350	1650	157	1317	30.1	7617	495	2699	7666
5.4-28	4709	9288	445	1063	1386	899	4	69	30.0	9288	4	69	9288
5.4-29	5087	9282	359	640	858	1399	119	246	21.0	10535	119	167	10535
5.4-30	3562	8913	280	434	652	124	0	0	9.9	10540	0	0	10540
5.4-31	6843	11992	270	499	860	330	4	6	15.4	14848	3	0	14848

(b) From the list of cities in Appendix 5A, "List of Cities and Climate Data", which contains data for 234 cities, select the closest city climatologically to the building site. If the site is not one of the cities listed or if the climate at the site differs significantly from a listed adjacent city, obtain the information from the weather bureau or other reliable source and use (a) above. The column designated "ACP Table No." contains the table number of the appropriate ACP Table.

(c) For information purposes only, the climate data used to develop the ACP tables for the above-grade wall section are shown in Table 5.4-32. The criteria for all other envelope sections was based on the most stringent level for the cities listed in the ACP Table.

5.4.3.2.2 Determination of Maximum Allowable Percent Fenestration.

(a) Using the appropriate ACP Table, determine the maximum allowable percent fenestration. The maximum allowable percent fenestration is the total area of fenestration assemblies divided by the total gross exterior wall area, considering all elevations of the building. Determining the maximum allowable percent fenestration requires the following five steps:

(1) Based on the Internal Load Density (ILD) for the proposed design, select one of the three Internal Load Ranges as the point of entry to the tables. Note for ILD's greater than 3.5 W/ft^2 use the 3.5 W/ft^2 range. For shell buildings, see procedures in Section 5.3.8. Determine the ILD of the proposed design, based on the sum of the Internal Lighting Power Allowance (ILPA), the Equipment Power Density (EPD) and Occupant Load Adjustment (OLA), as shown in Equation 5.4-1.

$$ILD = ILPA + EPD + OLA$$

Equation 5.4-1

Where:

The Internal Lighting Power Allowance (ILPA) shall be:

1. The building average Internal Lighting Power Allowance (ILPA) of the design building in W/ft^2 as determined in Section 3.4 or 3.5;

2. The average of the Lighting Power Budgets (LPB) for all activity areas within 15 ft of each exterior wall based on the procedures specified by the Systems Performance Criteria of Section 3.5.3, or

3. The actual lighting power density of the proposed design in W/ft^2, either the building average or the average of the lighting power within 15 ft of each exterior wall.

NOTE.—The lighting prescriptive path, Section 3.4, does not provide lighting values for health, assembly, multi-family high rise, and hotel/motel buildings type occupancies. Use the 1.51 to 3.0 range of Internal Load Density for health and assembly buildings; and the 0 to 1.5 range for multi-family high rise and hotel/motel buildings.

The Equipment Power Density (EPD) shall be either:

1. The building average receptacle power density selected from Table 5.4-33 in W/ft^2; or

Table 5.4-33
Average Receptacle Power Densities

BUILDING TYPE	W/ft^2
1. Assembly	0.25
2. Office	0.75
3. Retail	0.25
4. Warehouse	0.10
5. School	0.50
6. Hotel/Motel	0.25
7. Restaurant	0.10
8. Health	1.00
9. Multi-Family	0.75

2. The actual average receptacle power density for all activity areas within 15 ft of each exterior wall in W/ft^2, considering diversity. For determining compliance in Tables 5.4-2 through 5.4-31, the actual average receptacle power densities calculated by this method that exceed 1.0 W/ft^2 shall be limited to 1.0 W/ft^2 in Equation 5.4-1.

The Occupant Load Adjustment (OLA) shall be either:

1. 0.0 W/ft^2. This recognizes the assumed occupant sensible load of 0.6 W/ft^2 that is built into the ACP tables; or

2. A positive or negative difference between the actual occupant load and 0.6 W/ft^2 if the design building has a larger or smaller occupant load.

(2) *Select external shading projection factor (PF).* If no external shading projections are used in the proposed design, select the column designated Projection Factor=0.000–0.249. If external shading projections are used, determine the average area weighted projection factor on the window in accordance with Equation 5.4-2. Then select the appropriate column in the ACP Table.

$$PF = P_d / H$$

Equation 5.4-2

Where:

PF=Average area weighted projection factor

P_d=External horizontal shading projection depth, in. or ft

H=Sum of height of the fenestration and the distance from the top of the fenestration to the bottom of external shading projection in units consistent with P_d.

(3) Select the Shading Coefficient of the fenestration (SC_x) including internal, integral, and external shading devices, but excluding the effect of external shading projections (PF). This includes curtains, shades, or blinds. Reference *ASHRAE Handbook, 1985 Fundamentals Volume,* Chapter 27.

(4) Select one of the daylighting options, either:

1. Base Case, no daylighting; or

2. Perimeter Daylighting (automatic daylight controls for lighting system must be used). This option is not available in some locations.

(5) Select appropriate fenestration type. For most options, this is determined by the thermal transmittance value (U_{of}) of the fenestration assembly. For some fenestration options, the visible light transmittance (VLT) of the fenestration should not be less than the shading coefficient of the glazed portion of the fenestration assembly, not considering any shading devices. The ranges generally correspond to single glazing, double glazing, triple glazing and high performance glazing incorporating low emissivity coatings/films or more than two glazing layers. Each ACP table includes at most, three ranges of glazing U-value.

5.4.4.2.3 *Determine the Maximum U_{ow} for the Opaque Wall Assembly.* In the appropriate ACP Table the Maximum U_{ow} for the opaque wall assembly is determined using the following steps:

(a) For a lightweight wall assembly, heat capacity (HC) less than 5 Btu/ft²·°F, use the value indicated. This U_{ow} is constant over all internal load ranges.

(b) To use the mass wall adjustment, the following additional steps are necessary:

(1) Select the same internal load range as that used in determining the maximum allowable percent fenestration.

(2) Select the mass wall heat capacity (HC) and insulation position. If the wall insulation is positioned internal to or integral with the wall mass, use the column headed Interior/Integral Insulation. If the wall insulation is positioned external to the wall mass use the column headed Exterior Insulation. For HC less than 5 Btu/ft²·°F this adjustment table cannot be used. At this step you will have two choices of U_{ow} that are keyed to a small or large percent fenestration. This represents the full range of U_{ow} values allowed.

(3) Select or interpolate the appropriate maximum U_{ow} for the opaque wall based on the maximum allowable percent fenestration determined in Section 5.4.4.2.2 or the actual building percent fenestration whichever value is lower. The U_{ow} shall be determined by straight line interpolation for fenestration percentages between the smallest and largest values listed. If the design building percentage fenes-

tration is less than the smallest value listed, select the U_{ow} for the largest percentage fenestration listed.

5.4.4.2.4 *Determine Other Envelope Criteria.* In each ACP table, the criteria for roof, wall adjacent to unconditioned space, wall below grade (first story only), floor over unconditioned space, and slab-on-grade floors, shall be met. For heated slabs on grade, the R-value shall be the R-value for the unheated slab-on-grade plus 2.0. For skylights, the daylight credit procedure presented in Section 5.3.10 shall be used.

5.5 Building Envelope—System Performance Compliance Alternative

5.5.1 Roof Thermal Transmittance Criteria

5.5.1.1 Any building that is heated and/or mechanically cooled shall have an overall thermal transmittance value (U_{ow}) for the gross area of the roof assembly not greater than the value determined by Equation 5.5-1. The provisions of Section 5.3 shall be followed in determining acceptable combinations of materials that will meet the required U_{ow} values of Equation 5.5-1.

$$U_o = 1/(5.3 + 1.8 \times 10^{-3} \times HDD65 + 1.3 \times 10^{-3} \times CDD65 + 2.6 \times 10^{-4} \times CDH80)$$

Equation 5.5-1

5.5.1.2 Equation 5.5-1 applies only for climate locations with HDD65 less than or equal to 15,000. For climate locations with HDD65 greater than 15,000, see subsection 5.3.9, Table 5.3-5.

5.5.1.2.1 *Exceptions to Section 5.5.1.2*:

(a) any building that is only heated shall have an overall thermal transmittance value (U_{ow}) for the gross area of the roof assembly less than or equal to the value determined by Equation 5.5-1 with CDD65 and CDH80 set equal to zero; and

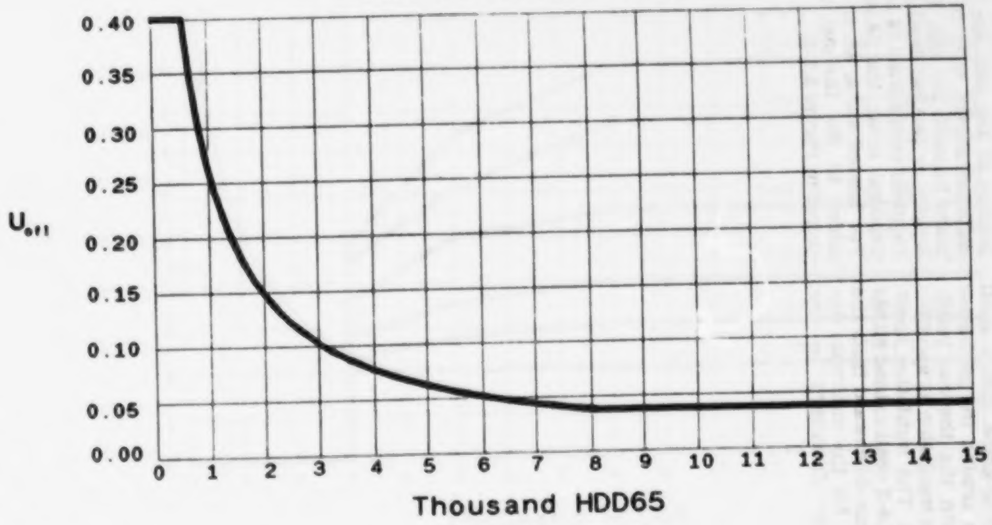
(b) any building that is only mechanically cooled shall have an overall thermal transmittance value (U_{ow}) for the gross area of the roof assembly less than or equal to the value determined by Equation 5.5-1 with HDD65 set equal to zero.

5.5.2 Floor Thermal Transmittance Criteria

5.5.2.1 The floors of any building that is heated and/or mechanically cooled shall meet the following thermal criteria:

5.5.2.1.1 Floors of conditioned spaces over unconditioned spaces shall have a thermal transmittance (U_{of}) not greater than that specified in Figure 5.5-1.

Figure 5.5-1
Maximum Overall Thermal Transmittance for Floors of Conditioned Spaces Over Unconditioned Spaces



Note:

for HDD65 ≤ 550, $U_{eff} = 0.40$

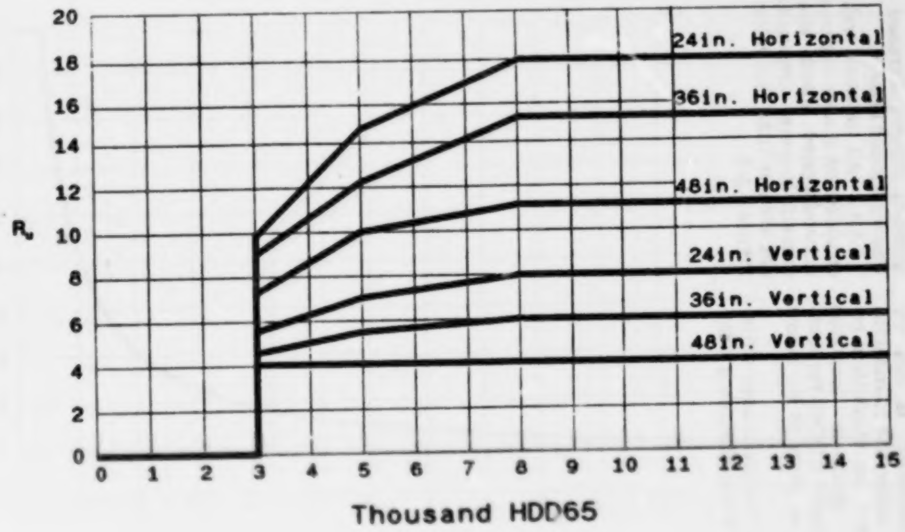
for 550 < HDD65 ≤ 8000, $U_{eff} = 1/[0.840 + 0.00302 \times HDD65]$

for 8000 < HDD65 < 15000, $U_{eff} = 0.04$

for HDD65 ≥ 15000, see Table 5.3-5

5.5.2.1.2 Slab-on-grade floors shall have insulation around the perimeter of the floor with the thermal resistance (R_u) of the insulation as specified in Figure 5.5-2. The insulation specified in Figure 5.5-2 shall extend either in a vertical plane downward from the top of the slab for the minimum distance shown or downward to the bottom of the slab for the minimum distance shown then in a horizontal plane beneath the slab. The horizontal length, or vertical depth, of insulation required varies from 24 in. to 48 in. depending upon the R-value selected. For heated slabs, an R of 2 shall be added to the thermal resistance required in Figure 5.5-2.

Figure 5.5-2
Thermal Resistance for Unheated
Slab on Grade



Note: for HDD65 ≤ 3000, $R_u = 0$
for 3000 > HDD65 > 15000, see graph above
for HDD65 ≥ 15000, see Table 5.3-5

R values for heated slab-on-grade = R unheated + 2;

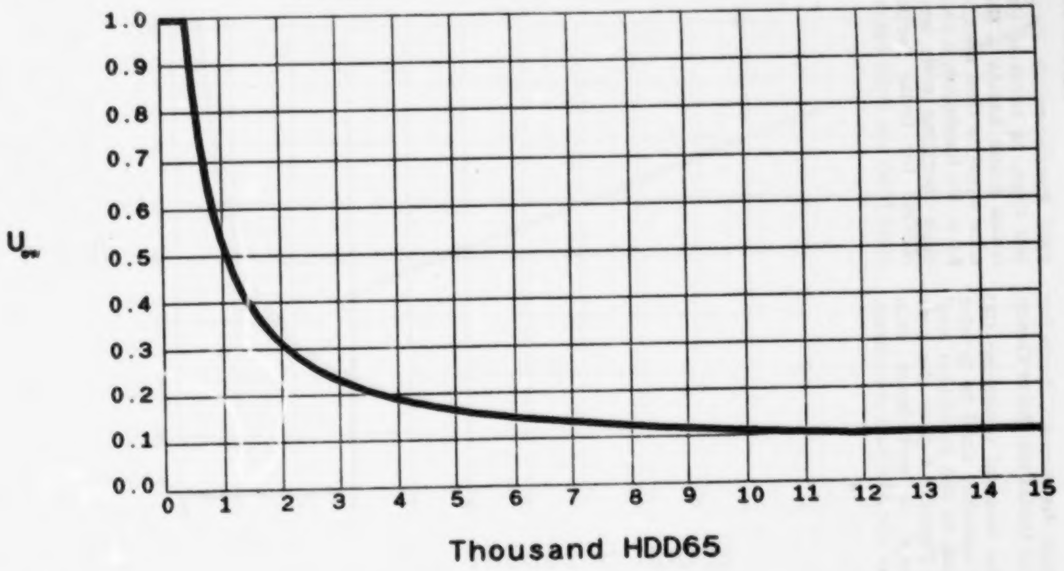
$R_h = R_u + 2$

(a) Vertical insulation is not required to extend below the foundation footing. There are no insulation requirements for slabs in locations having less than 3,000 HDD65 for footings extending less than 18 in. below grade.

5.5.3 Thermal Transmittance Criteria For Opaque Walls Enclosing Conditioned Spaces Exposed to Interior Unconditioned Spaces

5.5.3.1 All opaque walls enclosing conditioned spaces exposed to interior unconditioned spaces shall have an overall thermal transmittance (U_w) not greater than the value specified in Figure 5.5-3.

Figure 5.5-3
Maximum Overall Thermal Transmittance of
Opaque Wall Sections With HC < 7

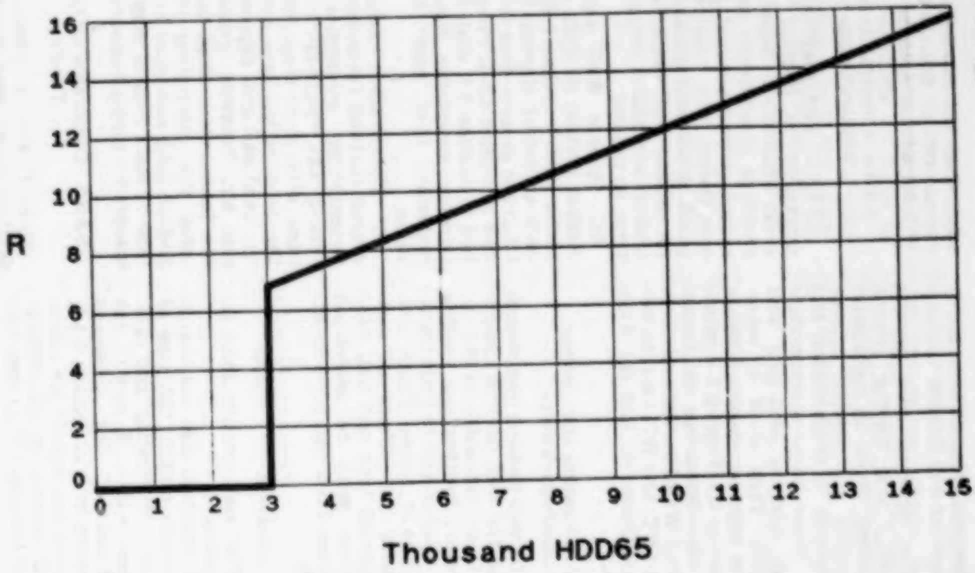


Note: for HDD65 ≤ 540, $U_{ow} = 1.0$
for 540 < HDD65 < 15000, $U_{ow} = 0.0528 + 510.9/\text{HDD65}$
for HDD65 ≥ 15000, see Table 5.3-5

5.5.4 Thermal Resistance Criteria for Exterior Wall Insulation Below Grade

5.5.4.1 The thermal resistance (R) of the wall assembly shall be greater than, or equal to the insulation level specified in Figure 5.5-4, or the heat loss calculated in accordance with Chapter 25 of the *ASHRAE Handbook, 1985 Fundamentals Volume* shall be less than, or equal to that of a wall below grade having a thermal resistance equal to that specified in Figure 5.5-4. No insulation is required for climate locations with less than 1,000 HDD65 for those portions of walls more than one story below grade.

Figure 5.5–4
Thermal Resistance of Wall
First Story Below Grade



Note: for HDD65 ≤ 3000, R = 0
for 3000 < HDD65 < 15000, R = 4.5 + 0.00075 x HDD65
for HDD65 ≥ 15000, see Table 5.3-5

5.5.5 External Wall Criteria for Heating and Cooling

5.5.5.1 The external wall heating criteria (WC_h) and cooling criteria (WC_c) represent limits on cumulative annual heating and cooling energy flux attributable to transmission and solar gain. These limits accommodate variation in internal load and wall heat capacity. They shall be determined for a building envelope design using Equations 5.5-2 and 5.5-6 in Attachment 5B, "Equations to Determine External Wall Heating and Cooling Criteria (WC_c and WC_h) and to Determine Compliance (C_t and H_t) With the Criteria."

5.5.6 Wall Heating and Cooling Compliance Values

5.5.6.1 The wall heating compliance value H_t and the wall cooling compliance value C_t are estimates of the cumulative annual heating and cooling energy flux attributable to heat transmission and solar gains. These estimates consider the effects of variations in internal load and wall heat capacity. They shall be calculated using Equations 5.5-2 and 5.5-6 in Attachment 5B.

5.5.6.3 Applying the Criteria

5.5.6.3.1 The wall criteria shall be applied as follows:

(a) For all buildings that are heated and mechanically cooled, the sum of the calculated wall heating and cooling compliance values, H_t and C_t, for all orientations of the proposed design, as determined in Section 5.5.6, shall not exceed the sum of the corresponding wall criteria for all orientations for wall heating (WC_h) and wall cooling (WC_c).

(b) For buildings that are only heated, the sum of the calculated wall heating compliance values, H_t, for all orientations of the proposed design, as determined in Section 5.5.6, shall not exceed the sum of the corresponding wall heating criterion WC_h for all orientations.

(c) For buildings that are only mechanically cooled, the sum of the calculated cooling compliance values, C_t, for all orientations of the proposed design, as determined from Section 5.5.6, shall not exceed the sum of the corresponding wall cooling criteria, WC_c for all orientations.

5.5.6.4 Constraints on Thermal Transmittance Values

5.5.6.4.1 The compliance calculation procedure in Section 5.5.6.3 allows great flexibility in selecting values for envelope components as long as the overall criteria are met. In calculating compliance, two constraints are imposed on thermal transmittance values for opaque wall assemblies and fenestration assemblies comprising the U_o term, as follows:

(a) *Opaque Wall Assemblies:* The opaque portion of walls with heat capacity (HC) less than 7 Btu/ft^2·°F shall have an overall thermal transmittance (U_{ow}) not greater than the value specified in Figure 5.5-4. Procedures, specified in Section 5.3, shall be used to determine acceptable combinations of materials that meet the required value.

(b) *Fenestration Assemblies:* The overall thermal transmittance (U_{of}) of fenestration assemblies shall not exceed 0.81 Btu/h·ft^2·°F for all locations with more than 3000 HDD65 if the fenestration area exceeds 10% of the total wall area exposed to the outside air. Thermal transmittance for the fenestration shall be determined using the calculation procedures in Section 5.3.1 and shall include the effects of sash, frames, edge effects, and spacers for multiple-glazed units.

5.5.6.5 Constraint on Daylighting Credit

5.5.6.5.1 For a given orientation, daylight credit may be used in Equations 5.5-2 and 5.5-6 only for that portion of the fenestration that is less than or equal to 65% of the gross wall area of the orientation.

5.5.6.6 Lighting Power Density

5.5.6.6.1 The Lighting Power Density used in calculating the compliance value shall be:

(a) The building average unit Interior Lighting Power Allowance of the proposed design in W/ft^2 as specified in Section 3.0;

(b) The average of the Lighting Power Budgets for all activity areas within 15 ft of each exterior wall based on the procedures set forth in Section 5.3; or

(c) The actual lighting power density of the proposed design in W/ft², either building average or average of the lighting power within 15 ft of each exterior wall.

5.5.6.7 Equipment Power Density

5.5.6.7.1 The equipment power density used in determining compliance shall be either:

(a) The "Average Receptacle Power Densities" from Table 5.4-32, or

(b) The actual average Equipment Unit Power Density, considering diversity, either building average or average in the activity areas within 15 ft of each exterior wall, not to exceed 1 W/ft².

5.5.6.8 Occupancy Loads

5.5.6.8.1 An occupancy load of 0.6 W/ft² is assumed. If the occupancy loads in the building design are different from this value, use the larger value.

Attachment 5A
List of Cities and Climate Data

NO	CITY	STATE	HDD50	HDD65	VSN	VSEW	VSS	CDD50	CDD65	CDH80	DR	#D HRS T<55	8AM-4PM 55<T<69	# TBL
Alabama														
28	Birmingham	AL	765	2862	464	797	906	5102	1825	6273	17.5	720	780	5A-7
143	Mobile	AL	164	1580	486	816	919	6478	2619	7679	16.4	408	771	5A-1
145	Montgomery	AL	491	2261	442	823	981	5821	2116	8473	19.3	609	734	5A-1
Alaska														
2	Adak	AK	2562	8913	280	634	682	124	0	0	9.9	2734	136	5A-9
9	Anchorage	AK	5301	10540	272	538	926	236	0	0	13.8	2398	321	5A-9
10	Annette Island	AK	2545	7277	285	482	739	756	12	0	10.1	2160	779	5A-9
26	Bethel	AK	8285	13449	252	453	789	312	0	0	14.3	2335	367	5A-9
25	Big Delta	AK	9355	14069	249	527	989	777	16	25	19.0	2161	606	5A-9
76	Fairbanks	AK	9861	14616	241	492	919	922	19	8	18.2	2083	662	5A-9
95	Gulkana	AK	8865	13866	257	522	943	498	4	6	18.5	2225	615	5A-9
100	Juneau	AK	4223	9350	254	410	642	348	0	0	12.7	2367	340	5A-9
106	King Salmon	AK	6863	11992	270	499	860	330	4	6	15.4	2395	502	5A-9
109	Kodiak	AK	3775	8806	276	509	852	360	6	0	10.6	2519	386	5A-9
132	McGrath	AK	9967	16068	246	467	861	578	3	0	15.9	2245	396	5A-9
152	Nome	AK	9061	14418	242	478	871	119	0	0	9.9	2710	210	5A-9
208	Summit	AK	9210	14530	247	488	895	155	0	0	13.4	2616	298	5A-9
231	Yakutat	AK	4486	9714	267	402	650	248	0	0	9.3	2471	439	5A-9
Arizona														
163	Phoenix	AZ	90	1382	488	1116	1310	7830	3647	34521	21.2	375	746	5A-8
171	Prescott	AZ	1677	4462	473	1090	1334	3385	895	3973	24.0	1021	735	5A-5
218	Tucson	AZ	178	1601	500	1112	1280	6822	2789	19657	21.9	399	716	5A-11
229	Winslow	AZ	1695	4603	471	1092	1338	3708	1161	7347	27.7	1130	634	5A-5
234	Yuma	AZ	43	782	495	1151	1330	8921	4186	37892	23.5	247	697	5A-8
Arkansas														
79	Fort Smith	AR	1169	3396	462	842	1005	5307	2077	10413	22.4	975	567	5A-9
121	Little Rock	AR	912	3091	465	831	981	5351	2035	8450	17.5	865	626	5A-1
California														
12	Arcata	CA	582	5020	407	736	926	1030	1	0	8.9	1396	1509	5A-6
19	Bakersfield	CA	305	2194	476	1053	1211	5679	2294	15447	28.9	645	868	5A-8
48	China Lake	CA	409	2444	468	1091	1312	6222	2782	26739	27.4	382	772	5A-11
58	Daggett	CA	257	1916	475	1102	1309	6516	2720	22302	27.0	472	861	5A-11
71	El Toro	CA	32	1577	486	977	1163	4764	874	2391	22.3	215	1474	5A-6
82	Fresno	CA	492	2700	459	1029	1199	5070	1803	13085	31.8	780	785	5A-8
122	Long Beach	CA	54	1483	482	956	1144	4947	980	1616	16.1	263	1540	5A-6
123	Los Angeles	CA	3	1696	482	962	1146	4454	472	136	14.1	145	1869	5A-6
146	Mount Shasta	CA	1967	5583	419	909	1153	2395	556	2073	16.2	1544	756	5A-8
156	Oakland	CA	157	2922	453	909	1182	2792	82	25	16.4	776	1985	5A-5
167	Point Mugu	CA	8	2195	477	936	1131	3435	145	70	12.3	209	2146	5A-5
176	Red Bluff	CA	589	2884	428	951	1177	5110	1950	14486	29.5	860	810	5A-8
185	Sacramento	CA	381	2753	444	987	1185	4274	1171	7315	34.6	834	995	5A-8
191	San Diego	CA	2	1275	490	950	1121	4865	462	385	11.5	102	1911	5A-6
192	San Francisco	CA	186	3258	454	941	1146	2496	73	206	20.2	782	1796	5A-5
196	Santa Maria	CA	138	3041	476	950	1128	2663	92	513	20.9	416	2016	5A-5
209	Sunnyvale	CA	142	2758	456	947	1145	3112	204	421	16.9	610	1796	5A-5
Colorado														
50	Colorado Springs	CO	2587	5996	435	976	1321	2557	491	2075	24.0	1357	725	5A-8
62	Denver	CO	2652	6083	428	971	1321	2611	567	2934	25.5	1329	739	5A-8
68	Eagle	CO	4232	8517	432	976	1296	1480	90	1030	35.4	1650	660	5A-8
86	Grand Junction	CO	2616	5701	438	1003	1303	3611	1221	6147	27.4	1383	518	5A-8
173	Pueblo	CO	2223	5285	442	992	1309	3384	971	5899	27.5	1077	720	5A-8
Connecticut														
95	Hartford	CT	2953	6277	384	646	834	2857	706	2197	23.7	1459	586	5A-8
Delaware														
227	Wilmington	DE	2133	5084	414	726	921	3402	1078	2180	17.2	1289	417	5A-8

C.1

ST CITY	STATE	HDD50	HDD65	VSN	VSEW	VSS	CDD50	CDD65	CDH80	DR	NO HRS T<55	8AM-4PM 55<T<69	ACP TABLE
District of Columbia													
Washington	DC	2004	4820	619	726	900	3734	1083	3990	18.6	1288	487	5.4-20
FLORIDA													
Apalachicola	FL	163	1366	548	887	971	6867	2695	6289	14.3	322	778	5.4-10
Daytona	FL	81	787	503	860	953	7406	2626	5252	14.8	177	661	5.4-10
Jacksonville	FL	206	1357	495	864	963	7063	2721	7480	16.4	354	676	5.4-10
Miami	FL	3	185	527	876	956	9536	4065	9166	12.4	55	259	5.4-12
Orlando	FL	33	532	511	881	976	8200	3312	9757	17.1	131	571	5.4-12
Tallahassee	FL	307	1721	495	865	964	6652	2601	7323	16.1	421	767	5.4-10
Tampa	FL	37	575	518	890	976	7885	3047	8985	14.9	147	592	5.4-10
West Palm Beach	FL	0	177	519	846	906	9203	3906	10524	13.1	22	308	5.4-12
GEORGIA													
Atlanta	GA	866	3070	467	807	950	4857	1566	3799	17.6	915	769	5.4- 7
Augusta	GA	464	2586	468	805	953	5456	1904	6906	21.3	690	774	5.4- 7
Macon	GA	514	2330	476	822	939	5769	2111	8097	18.7	667	787	5.4- 9
Savannah	GA	410	1967	474	885	926	6112	2196	6308	16.6	529	725	5.4- 9
HAWAII													
Barbers Point	HI	0	3	592	978	965	9514	3862	3617	11.2	1	97	5.4- 2
Hilo	HI	0	0	557	817	805	8494	3019	1112	11.0	0	153	5.4- 2
Honolulu	HI	0	0	588	953	932	9625	4150	4537	9.8	0	69	5.4- 2
Lihue	HI	0	2	567	895	885	9219	3746	1912	9.6	0	140	5.4- 2
IDAHO													
Boise	ID	2276	5467	399	916	1228	2828	764	4512	28.9	1542	667	5.4-22
Lewiston	ID	2015	5426	370	729	980	2709	645	4121	29.7	1467	748	5.4-20
Pocatello	ID	3404	7075	405	935	1262	2330	536	3295	32.8	1681	546	5.4-27
ILLINOIS													
Chicago	IL	3000	6151	402	729	956	3339	1015	3190	16.6	1426	613	5.4-21
Moline	IL	3085	6250	405	734	959	3206	896	2808	19.5	1357	648	5.4-21
Springfield	IL	2490	5448	422	768	962	3675	1150	4038	20.2	1260	609	5.4-23
INDIANA													
Evansville	IN	1948	4625	426	736	890	4063	1265	4288	18.4	1141	611	5.4-23
Fort Wayne	IN	3023	6145	395	664	826	3096	743	1629	17.7	1600	681	5.4-21
Indianapolis	IN	2624	5620	407	692	851	3430	951	2063	18.0	1375	602	5.4-21
South Bend	IN	3038	6280	396	690	857	2917	686	1840	21.1	1415	635	5.4-21
IOWA													
Burlington	IA	3009	6094	419	802	1050	3393	1002	2548	17.1	1354	649	5.4-21
Des Moines	IA	3275	6467	413	788	1027	3116	812	2383	17.5	1425	667	5.4-25
Mason City	IA	4311	7735	400	783	1053	2708	658	1082	20.8	1548	610	5.4-26
Sioux City	IA	3608	6750	406	794	1064	3326	995	3488	18.6	1438	602	5.4-25
KANSAS													
Dodge City	KS	2280	5131	450	942	1196	4008	1384	7186	26.0	1252	637	5.4-26
Goodland	KS	2757	6890	434	935	1228	3047	905	5147	26.3	1358	625	5.4-32
Topeka	KS	2458	5201	434	837	1068	4120	1388	3212	22.3	1192	688	5.4-25
KENTUCKY													
Covington	KY	2154	5030	408	687	843	3656	1057	2638	18.3	1316	661	5.4-20
Lexington	KY	1921	4669	425	729	872	3906	1137	2803	15.6	1211	618	5.4-25
Louisville	KY	1851	4539	424	727	883	4144	1357	4716	17.6	1192	634	5.4-25
LOUISIANA													
Baton Rouge	LA	257	1573	488	806	889	6682	2543	8814	17.2	440	677	5.4- 9
Lake Charles	LA	214	1455	489	795	864	6849	2615	7883	14.8	396	668	5.4- 9
New Orleans	LA	179	1392	497	838	923	6848	2578	7388	15.1	326	789	5.4- 9
Shreveport	LA	447	2265	484	843	954	6022	2346	10039	18.1	687	697	5.4- 9
MAINE													
Bangor	ME	4132	7998	378	695	950	1853	243	434	21.5	1721	669	5.4-26
Caribou	ME	5297	9683	357	649	922	1410	121	205	18.1	1862	602	5.4-29
Portland	ME	3531	7505	376	643	856	1946	245	399	19.6	1604	665	5.4-25

C.2

NO CITY	STATE	HDD50	HDD65	VSN	VSEW	VSS	CDD50	CDD65	CDH80	DR	NO HRS T<55	8AM-4PM 55<T<69	[illegible] TABLE
Maryland													
20 Baltimore	MD	2020	4946	419	739	932	3683	1134	3825	18.6	1268	593	[illegible]
161 Patuxent	MD	1618	4052	429	758	943	4180	1289	2966	12.9	1118	729	5.4-17
Massachusetts													
31 Boston	MA	2416	5775	387	659	849	2810	695	1601	16.5	1495	713	[illegible]
Michigan													
7 Alpena	MI	4282	8164	371	661	862	1928	335	894	17.3	1707	695	[illegible]
64 Detroit	MI	2799	5997	390	676	858	3199	922	2238	18.8	1406	632	[illegible]
78 Flint	MI	3471	6917	379	641	811	2502	673	921	18.1	1563	634	[illegible]
87 Grand Rapids	MI	3392	6777	390	688	872	2680	590	1461	22.2	1562	632	[illegible]
195 Sault Sainte Marie	MI	5087	9282	359	640	858	1399	119	246	21.0	1838	733	[illegible]
216 Traverse City	MI	3954	7654	369	642	818	2195	438	1124	21.0	1651	679	[illegible]
Minnesota													
67 Duluth	MN	5797	9918	355	633	806	1311	157	258	20.0	1882	650	[illegible]
102 International Falls	MN	[illegible]	10535	351	669	962	[illegible]	119	167	22.0	1870	656	[illegible]
140 Minneapolis	MN	[illegible]	8060	380	709	972	2751	773	2509	20.7	1620	566	[illegible]
181 Rochester	MN	[illegible]	8100	383	691	927	2360	442	590	18.8	1584	652	[illegible]
Mississippi													
103 Jackson	MS	546	2424	481	833	962	5927	2330	8789	17.2	646	640	[illegible]
135 Meridian	MS	546	2446	480	811	905	5723	2148	9508	20.2	613	719	[illegible]
Missouri													
51 Columbia	MO	2225	4994	431	790	972	3940	1234	4262	21.5	1189	633	[illegible]
186 Saint Louis	MO	2111	4860	432	797	983	4195	1467	5379	18.7	1124	614	[illegible]
206 Springfield	MO	1839	4509	446	812	982	4115	1311	4170	20.4	1215	544	[illegible]
Montana													
26 Billings	MT	3627	7156	380	814	1160	2544	598	2695	25.6	1650	617	[illegible]
57 Cutbank	MT	4718	8941	357	768	1150	1368	117	702	27.6	1834	672	[illegible]
65 Dillon	MT	4140	8210	386	838	1187	1564	159	784	28.6	[illegible]	639	[illegible]
83 Glasgow	MT	5082	8828	361	752	1115	2272	543	2642	26.0	1688	570	[illegible]
88 Great Falls	MT	3728	7454	366	776	1133	2199	450	1886	26.7	1684	641	[illegible]
96 Helena	MT	3926	7817	372	771	1098	1911	328	1771	28.3	1784	651	[illegible]
118 Lewistown	MT	4027	8089	368	753	[illegible]	1629	216	1270	29.8	1740	673	[illegible]
138 Miles City	MT	4435	7989	374	800	1156	2694	773	4344	26.9	1588	565	[illegible]
142 Missoula	MT	3492	7560	363	704	957	1629	221	1513	30.8	1843	658	[illegible]
Nebraska													
85 Grand Island	NE	3315	6477	420	843	1115	3309	996	4580	26.5	1431	611	[illegible]
155 North Platte	NE	3447	6905	419	880	1183	2731	715	3468	26.2	1514	592	[illegible]
159 Omaha	NE	2981	5968	416	806	1066	3618	1130	3883	19.6	1355	586	[illegible]
197 Scottsbluff	NE	3335	6900	413	861	1168	2603	695	3745	28.3	1457	620	[illegible]
Nevada													
72 Elko	NV	3345	7178	420	1000	1332	1997	355	4065	37.8	1540	569	[illegible]
73 Ely	NV	3683	7666	432	1014	1350	1650	157	1317	30.1	1529	683	[illegible]
116 Las Vegas	NV	449	2399	456	1136	1417	6567	3043	26408	25.5	604	719	5.4-11
125 Lovelock	NV	2638	5845	418	1094	1452	2813	745	6659	34.7	1356	686	[illegible]
178 Reno	NV	2181	5841	428	1068	1401	2180	365	4059	39.3	1306	752	[illegible]
214 Tonopah	NV	2308	5652	427	1130	1502	2742	611	3777	28.4	1257	660	[illegible]
228 Winnemucca	NV	2774	6471	418	1014	1350	2284	486	6346	41.0	1383	608	[illegible]
233 Yucca Flats	NV	1664	4802	450	1112	1399	3378	1041	11560	35.9	1004	670	[illegible]
New Hampshire													
54 Concord	NH	3742	7425	375	630	824	2254	463	1865	22.6	1533	683	[illegible]
New Jersey													
114 Lakehurst	NJ	2174	5265	407	712	917	3299	915	3019	20.5	1312	645	[illegible]
151 Newark	NJ	2027	4956	406	710	912	3556	1009	2487	17.7	1325	644	[illegible]

NO CITY	STATE	HDD50	HDD65	VSN	VSEW	VSS	CDD50	CDD65	CDH80	DR	NO HRS T<55	8AM-4PM 55<T<69	ACP TABLE
ew Mexico													
5 Albuquerque	NM	1633	4425	469	1105	1361	3942	1257	5705	25.3	1148	703	5.4-18
48 Clayton	NM	2138	5176	457	1019	1310	3122	685	2893	20.0	1150	770	5.4-22
186 Roswell	NM	1008	3486	490	1081	1280	4536	1539	11135	26.1	825	677	5.4-18
217 Truth or Consequences	NM	1076	3392	488	1113	1326	4457	1500	6882	23.4	889	764	5.4-18
219 Tucumcari	NM	1344	3922	470	1046	1300	4451	1554	8426	26.9	914	710	5.4-18
ew York													
4 Albany	NY	3488	6770	395	719	942	2812	619	1308	19.7	1487	605	5.4-25
27 Binghamton	NY	3885	7397	370	592	733	2373	410	672	18.5	1657	662	5.4-25
36 Buffalo	NY	3213	6721	371	609	746	2476	509	779	19.2	1571	697	5.4-25
131 Massena	NY	4583	8397	380	708	942	2026	365	913	20.9	1674	627	5.4-26
149 New York (Central Pk)	NY	1986	5022	392	650	817	3273	834	911	12.5	1335	790	5.4-20
150 New York (LAG)	NY	1986	5022	392	650	817	3273	834	911	12.5	1335	790	5.4-20
182 Rochester	NY	3482	6995	374	622	771	2557	595	1642	20.1	1612	608	5.4-25
218 Syracuse	NY	3448	6856	371	611	764	2579	513	926	20.2	1521	730	5.4-25
rth Carolina													
13 Asheville	NC	1407	4203	449	782	946	3442	763	1298	21.1	1083	915	5.4-15
37 Cape Hatteras	NC	635	2745	460	819	972	4978	1613	2039	10.0	765	820	5.4- 7
43 Charlotte	NC	1086	3412	456	809	968	4698	1549	4299	19.6	892	777	5.4-17
45 Cherry Point	NC	569	2556	461	826	996	5277	1788	3614	15.2	690	757	5.4- 7
90 Greensboro	NC	1261	3760	449	810	994	4274	1298	3:42	17.4	1018	718	5.4-17
176 Raleigh	NC	1131	3509	445	774	955	4485	1389	3697	16.5	918	740	5.4-17
rth Dakota													
29 Bismarck	ND	5196	8992	371	766	1114	2175	496	2067	27.8	1724	556	5.4-29
77 Fargo	ND	5582	9242	371	751	1077	2388	573	2288	22.2	1730	546	5.4-29
141 Minot	ND	5336	9178	358	724	1059	2064	431	1570	24.5	1800	581	5.4-29
hio													
3 Akron	OH	2881	6172	396	664	812	2845	661	1100	17.3	1460	680	5.4-21
53 Columbus	OH	2424	5493	401	671	819	3195	789	2268	22.6	1375	708	5.4-20
59 Dayton	OH	2573	5549	408	696	855	3367	868	1346	17.1	1386	611	5.4-20
213 Toledo	OH	3132	6514	393	676	853	2791	698	1794	17.8	1500	652	5.4-21
232 Youngstown	OH	3129	6557	383	624	764	2593	546	1128	21.4	1523	679	5.4-21
klahoma													
157 Oklahoma City	OK	1617	3825	465	875	1053	4901	1834	8878	20.8	980	733	5.4-18
220 Tulsa	OK	1429	3732	453	820	991	5244	2072	10065	19.7	983	591	5.4-19
regon													
14 Astoria	OR	1080	5226	350	588	782	1357	29	145	12.3	1571	1236	5.4-14
133 Medford	OR	1531	4893	405	814	1005	2681	568	4081	32.9	1442	769	5.4-15
154 North Bend	OR	629	4678	392	740	977	1629	2	0	11.8	1351	1553	5.4- 6
170 Portland	OR	1151	4577	364	647	841	2321	272	1086	22.8	1421	1060	5.4-14
177 Redmond	OR	2535	6665	395	835	1127	1573	228	2390	34.4	1631	695	5.4-20
187 Salem	OR	1128	4926	373	680	874	1849	172	1224	29.3	1499	916	5.4-14
ennsylvania													
6 Allentown	PA	2692	5760	401	682	864	3105	698	1146	17.0	1335	710	5.4-21
18 Avoca	PA	2931	6236	389	646	811	2823	652	1547	19.7	1505	705	5.4-21
74 Erie	PA	3006	6426	384	646	792	2527	472	378	14.8	1532	716	5.4-21
94 Harrisburg	PA	2302	5251	404	687	864	3518	992	2860	20.1	1342	648	5.4-20
162 Philadelphia	PA	2044	4923	408	701	889	3661	1065	3172	17.1	1286	646	5.4-20
165 Pittsburgh	PA	2773	5907	392	642	780	2989	648	1040	19.0	1426	700	5.4-21
ode Island													
172 Providence	RI	2610	6022	393	677	874	2756	695	1284	16.8	1429	684	5.4-21
uth Carolina													
41 Charleston	SC	435	2194	467	796	925	5722	2005	5249	16.4	570	767	5.4- 9
52 Columbia	SC	694	2666	467	816	953	5613	2110	8541	19.5	741	705	5.4- 9
91 Greenville	SC	907	3220	459	814	971	4563	1400	3494	17.7	866	851	5.4- 7

NO CITY	STATE	HDD50	HDD65	VSN	VSEW	VSS	CDD50	CDD65	CDH80	DR	NO HRS T<55	8am-4pm 55<T<69	AP TBL
South Dakota													
100 Huron	SD	4820	8351	390	769	1044	2718	774	3739	24.5	1630	565	5.4-8
164 Pierre	SD	4028	7358	392	822	1147	3079	934	5262	24.2	1544	557	5.4-8
175 Rapid City	SD	3672	7229	394	819	1142	2581	663	3477	28.2	1530	572	5.4-8
203 Sioux Falls	SD	4240	7683	394	778	1078	2811	779	3829	20.2	1553	599	5.4-8
Tennessee													
44 Chattanooga	TN	1232	3595	444	738	849	4652	1541	5079	17.6	1050	686	5.4-17
108 Knoxville	TN	1283	3818	446	752	878	4455	1514	3840	17.8	1076	725	5.4-17
134 Memphis	TN	1034	3259	460	806	935	5319	2069	7807	19.2	865	851	5.4-19
147 Nashville	TN	1165	3609	443	749	863	4503	1952	5078	18.2	897	769	5.4-17
Texas													
1 Abilene	TX	792	2714	494	924	1066	5968	2416	13206	21.5	760	648	5.4-11
8 Amarillo	TX	1992	4331	471	1013	1253	4113	1377	6763	23.9	1109	680	5.4-11
17 Austin	TX	271	1735	503	877	972	6873	2862	14095	19.3	564	664	5.4-11
32 Brownsville	TX	35	662	547	908	908	8531	3664	12218	16.8	191	422	5.4-12
55 Corpus Christi	TX	106	889	529	906	946	8200	3508	13109	17.2	249	543	5.4-12
61 Del Rio	TX	186	1397	511	903	1008	7376	3112	14870	19.8	474	732	5.4-11
70 El Paso	TX	522	2605	503	1133	1306	5617	2225	13224	21.3	660	755	5.4-11
81 Fort Worth	TX	605	2354	485	875	994	6174	2648	13682	20.5	673	772	5.4-11
99 Houston	TX	195	1346	490	805	883	7215	2891	10569	18.2	352	703	5.4-1
107 Kingsville	TX	49	874	527	881	922	8302	3652	15512	19.2	260	525	5.1-12
115 Laredo	TX	65	842	532	900	936	8827	4130	25225	21.4	286	598	5.4-11
126 Lubbock	TX	1173	3643	488	1070	1267	6754	1749	9827	25.1	917	743	5.4-11
127 Lufkin	TX	370	1846	492	848	942	6667	2648	11737	21.5	478	681	5.4-11
137 Midland	TX	634	2573	504	1079	1247	5695	2159	11177	25.9	698	729	5.4-11
168 Port Arthur	TX	167	1416	497	824	900	6888	2662	8837	17.4	386	687	5.4-1
189 San Angelo	TX	538	2110	503	944	1076	6522	2619	14621	20.6	641	619	5.4-11
190 San Antonio	TX	261	1579	510	878	955	7170	3013	13841	20.1	442	690	5.4-11
200 Sherman	TX	699	2708	476	862	996	5844	2578	12065	20.2	785	721	5.4-11
221 Waco	TX	488	2166	495	874	972	6676	2979	15658	21.1	651	622	5.4-11
226 Wichita Falls	TX	984	3049	480	911	1077	5708	2299	14487	18.8	802	725	5.4-11
Utah													
33 Bryce Canyon	UT	4709	9288	445	1063	1386	899	4	69	30.0	1660	841	5.4-28
40 Cedar City	UT	2592	5888	467	1054	1342	2802	624	3119	27.1	1392	629	5.4-22
188 Salt Lake City	UT	2570	5975	422	975	1266	3011	941	7030	29.1	1426	586	5.4-22
Vermont													
36 Burlington	VT	4211	7932	382	698	925	2118	365	490	18.3	1697	637	5.4-26
Virginia													
153 Norfolk	VA	1185	3609	443	792	964	4636	1586	4554	15.0	1014	685	5.4-17
179 Richmond	VA	1322	3895	430	745	923	4225	1323	4021	17.6	996	716	5.4-17
180 Roanoke	VA	1520	4192	433	763	946	3986	1183	3306	19.0	1148	715	5.4-17
Washington													
158 Olympia	WA	1546	5550	351	619	819	1550	79	466	26.4	1577	985	5.4-16
198 Seattle/Tacoma	WA	1382	5281	350	621	828	1683	106	256	16.5	1700	982	5.4-16
205 Spokane	WA	2983	6727	363	758	1064	2094	363	1595	25.3	1669	640	5.4-21
225 Whidbey Island	WA	1179	5274	344	630	878	1403	22	7	14.8	1671	1189	5.4-16
230 Yakima	WA	2323	5877	373	790	1091	2370	449	3285	31.2	1413	703	5.4-28
West Virginia													
42 Charleston	WV	1816	4587	409	667	798	3712	1008	3054	20.8	1215	784	5.4-23
Wisconsin													
69 Eau Claire	WI	4751	8295	376	683	923	2545	663	1898	18.2	1565	661	5.4-26
89 Greenbay	WI	4310	8039	380	696	947	2172	426	957	22.1	1604	651	5.4-26
112 La Crosse	WI	3838	7243	386	701	937	2786	716	2121	18.9	1568	646	5.4-25
129 Madison	WI	4009	7466	391	717	955	2559	542	1329	19.1	1511	658	5.4-26
139 Milwaukee	WI	3586	7121	396	726	941	2427	487	1013	17.1	1587	618	5.4-25

C.5

ID CITY	STATE	HDD50	HDD65	VSN	VSEW	VSS	CDD50	CDD65	CDH80	DR	NO HRS T<55	8AM-4PM 55<T<69	ACP TABLE
Wyoming													
39 Casper	WY	3824	7617	403	961	1343	2177	495	2699	29.8	1670	535	5.4-27
46 Cheyenne	WY	3435	7218	416	906	1267	1965	271	1040	26.4	1618	608	5.4-27
165 Rock Springs	WY	4407	8391	411	1012	1395	1698	207	702	29.1	1828	552	5.4-28
197 Sheridan	WY	3605	7366	387	806	1133	2074	360	2105	30.8	1650	574	5.4-25
Other Locations Outside U.S.A.													
92 Guantanamo Bay	CU	0	0	612	1045	1018	11071	5596	18452	15.5	0	17	5.4- 3
110 Koror Island	PN	0	0	662	890	827	11435	5960	14548	9.5	0	0	5.4- 3
111 Kwajalein Island	PN	0	0	678	961	888	11635	6160	16217	8.2	0	0	5.4- 3
185 San Juan	PR	0	0	608	963	951	10668	5173	11563	12.7	0	14	5.4- 3
222 Wake Island	PN	0	0	609	1002	977	10869	5394	10167	9.7	0	0	5.4- 3

C.6

ATTACHMENT 5B TO SECTION 435.105

EQUATIONS TO DETERMINE EXTERNAL WALL HEATING AND COOLING CRITERIA AND TO DETERMINE COMPLIANCE WITH THE CRITERIA

5B.1 Equations and Coefficients

This attachment contains the external wall equations for use in determining external wall heating and cooling criteria (WC_h and WC_c) and for determining compliance (H_i and C_i) with the criteria for north, east, south and west orientations. For NE, NW, SW and SE orientations, WC_h, WC_c, H_i and C_i shall be determined by treating half of each wall area as though it faces each of the adjacent cardinal directions, e.g., treat NE as half north and half east.

Equations 5.5-2 and 5.5-6 are statistical regression equations that correlate envelope cooling and heating loads, respectively, from thermal transmission and solar gains, as modified by internal gain and mass, to the physical components of the envelope. Seven individual terms are identified for both cooling and heating that correlate variables with physical meaning such as U-values, internal gains, and weather related variables. They are as follows:

1. CLU, CLUO, CLXUO: Terms that correlate cumulative annual cooling loads with thermal transmittance of the wall.
2. CLM: Term that correlates cumulative annual cooling loads with heat capacity of the wall.
3. CLG: Term that correlates cumulative annual cooling loads with internal gains from occupant light and equipment.
4. CLS: Term that correlates cumulative annual cooling loads with incident solar gains.
5. CLC: Term that correlates cumulative annual cooling loads with climate variables for a specific location.
6. HLU, HLUO, HLXUO: Terms that correlate cumulative annual heating loads with thermal transmittance of the wall.
7. HLM: Term that correlates cumulative annual heating loads with heat capacity of the wall.
8. HLG: Term that correlates cumulative annual heating loads with internal gains from occupants, lights, and equipment.
9. HLS: Term that correlates cumulative annual heating loads with incident solar gains.

10. HLC: Term that correlates cumulative annual heating loads with climate variables for a specific location.

The cooling and heating equations with their coefficients follow.

Cooling Equation

$$UC_c \text{ or } C_1 = CLU_i + CLUO_i + CLXUO_i + CLM_i + CLG_i + CLS_i + CLC_i$$

Equation 5.5-2

Where:

i = for each orientation

j = for each wall mass construction type for the orientation

$$\begin{aligned}
CLU &= FO \times U_{OW} \times [\, CU1 \times CDH80 \\
&\quad + CU2 \times CDH80^2 \\
&\quad + CU3 \times (VS \times CDH80)^2 \\
&\quad + CU4 \times DR \,]
\end{aligned}$$

$$\begin{aligned}
CLUO &= FC \times UOC \times [\, CUO1 \times EA \times VS \times CDD50 \\
&\quad + CUO2 \times G \\
&\quad + CUO3 \times G^2 \times EA^2 \times VS \times CDD50 \\
&\quad + CUO4 \times G^2 \times EA^2 \times VS \times CDD65 \,]
\end{aligned}$$

$$\begin{aligned}
CLXUO &= FC \times 1/UOC \times [\, CXUO1 \times EA \times VS \times CDD50 \\
&\quad + CXUO2 \times EA \times (VS \times CDD50)^2 \\
&\quad + CXUO3 \times G \times CDD50 \\
&\quad + CXUO4 \times G^2 \times EA^2 \times VS \times CDD50 \\
&\quad + CXUO5 \times G^2 \times CDD65 \,]
\end{aligned}$$

$$\begin{aligned}
CLM &= FO_j \times CMC_i \times [\, CM1 + CM2 \times EA \times VS \times CDD50 \\
&\quad + CM3 \times EA \times VS \times CDD65 \\
&\quad + CM4 \times EA^2 \times VS \times CDD50 \\
&\quad + CM5 \times G^2 \times CDD65 \\
&\quad + CM6 \times G \times CDD50 \\
&\quad + CM7 \times G \times CDD65 \\
&\quad + CM8 \times G \times EA \times VS \times CDD50 \,]
\end{aligned}$$

$$\begin{aligned}
CLG &= FC \times (\, G \times [\, CG1 + CG2 \times CDD50 \\
&\quad + CG3 \times EA \times (VS \times CDD50)^2 \\
&\quad + CG4 \times EA^2 \times VS \times CDD50 \\
&\quad + CG5 \times CDD65 \\
&\quad + CG6 \times CDD50^3 \\
&\quad + CG7 \times CDD65^3 \,] \\
&\quad + G^2 \times [\, CG8 \times EA \times VS \times CDD50 \\
&\quad + CG9 \times EA^2 \times VS \times CDD50 \,] \,)
\end{aligned}$$

$$
\begin{aligned}
\mathrm{CLS} = \mathrm{FC} \times (\mathrm{EA} \times [\ & \mathrm{CS1} + \mathrm{CS2} \times \mathrm{VS} \times \mathrm{CDD50} \\
& + \mathrm{CS3} \times (\mathrm{VS} \times \mathrm{CDD50})^2 \\
& + \mathrm{CS4} \times \mathrm{VS} \times \mathrm{CDD65} \\
& + \mathrm{CS5} \times (\mathrm{VS} \times \mathrm{CDD65})^2\ ] \\
& + \mathrm{EA}^2 \times [\ \mathrm{CS6} + \mathrm{CS7} \times (\mathrm{VS} \times \mathrm{CDD65})^2\ ]\ )
\end{aligned}
$$

$$
\begin{aligned}
\mathrm{CLC} = \mathrm{FC} \times [\ & \mathrm{CC1} \times \mathrm{CDD50} \\
& + \mathrm{CC2} \times \mathrm{CDD50}^2 \\
& + \mathrm{CC3} \times \mathrm{CDH80} \\
& + \mathrm{CC4} \times \mathrm{CDH80}^2 \\
& + \mathrm{CC5} \times \mathrm{CDD65} \\
& + \mathrm{CC6} \times (\mathrm{VS} \times \mathrm{CDD65})^2 \\
& + \mathrm{CC7} \times \mathrm{VS} \times \mathrm{CDD50} \\
& + \mathrm{CC8} \times (\mathrm{VS} \times \mathrm{CDD50})^2 \\
& + \mathrm{CC9} \times (\mathrm{VS} \times \mathrm{CDH80})^2 \\
& + \mathrm{CC10} \times \mathrm{VS} \\
& + \mathrm{CC11} \times \mathrm{DR} \\
& + \mathrm{CC12} \times \mathrm{DR}^2 \\
& + \mathrm{CC13}\ ]
\end{aligned}
$$

NOTE: The coefficients for various orientations in the equations listed above are found in Table 58-2. If WC_c or C_1 is less than 0.0, WC_c or C_1 is set equal to 0.0.

Where:

Climate Data

CDD50 = Cooling degree-days base 50 °F

CDD65 = Cooling degree-days base 65 °F

CDH80 = Cooling degree-hours base 80 °F

DR = Average daily temperature range for warmest month.

VS = Annual average daily incident solar energy on facade under consideration, Btu/ft^2/day.

Building Data

FC = Wall area (opaque and glazed) of zone under consideration divided by total wall area (opaque and glazed) of all zones.

FO = Opaque wall area of zone under consideration divided by total wall area (opaque and glazed) of all zones. If multiple mass constructions are present, the FO_j is calculated for each construction j and used to form the area weighted mass correction.

U_{OW} = Area average U-value of opaque walls (including those of mass construction) in zone under consideration.

UOC = Area average U-value of wall (opaque and glazed, evaluated under cooling conditions) in zone under consideration. UOC is equal to UOH.

WWR = Window wall ratio for zone under consideration; defined as fenestration area divided by total wall area (opaque and glazed).

EA = Effective aperature fraction for zone under consideration, where:

$$EA = WWR \times SC_x \times S_{ec}$$

Equation 5.5-3

Where:

S_{ec} = The cooling adjustment factor for horizontal external shading projections:

For $0.0 \leq PF \leq 0.5$ from Equation 5.4-1

For the north orientation:

$$S_{ec} = 1 - 0.4 \times PF$$

Equation 5.5-3a

For the east, south and west orientations:

$$S_{ec} = 1.0 - 1.4877 \times PF + 1.0489 \times PF^2$$

Equation 5.5-3b

G = Effective internal gain (W/ft^2) for zone under consideration, where:

$$G = E_p + L_p \times (1 - R_c \times K_d) + O_l$$

Equation 5.5-4

Where:

L_p = Lighting power, from Section 5.5.7.4

E_p = Equipment power, from Section 5.5.7.5

R_c = The ratio of the electric lights in the same space served by the orientation that have automatic controls for daylighting.

O_l = Occupant load adjustment, from Section 5.5.7.6

$$K_d = 5.871\ (WWR \times VLT \times S_{ec})\ -13.311\ (WWR \times VLT \times S_{ec})^2$$

Equation 5.5-4a

If (WWR x VLT x S_{ec}) > 0.22, then K_d = 0.647

Where:

WWR = As defined above, but not to exceed a maximum value of 0.65 in Equation 5.5-4a, per Section 5.5.7.3.

VLT = Visible light transmittance of the glazing material, as defined in Section 5.5.2.1, including any shading devices present that modify the visible transmittance of the glazing material.

CDC = Mass correction (Cooling Delta Load Factor) from Equation 5.5-5. If multiple mass constructions are present, each CDC_j is evaluated separately and combined by area weighting. If the U-value of the mass wall is less than 0.05, then U_{mw} = 0.05 shall be used to calculate the CDC. If the value of HC is greater than 20, then HC = 20 shall be used to calculate the CDC.

COOLING DELTA LOAD FACTOR EQUATIONS

Equation 5.5-5 is used to predict the Cooling Delta Load Factor values.

CDC = Cooling Delta Load Factor =

$$\left| 1 - e^{-CP_1(HC-1)} \right| \left| CP_2 + CP_3U - \frac{CP_4}{1 + (CP_5 + CP_6U)e^{-(CP_7+CP_8U^2)(HC-1)}} \right| \left| \frac{1.0}{0.7} \right|$$

Equation 5.5-5

Where:

HC = Wall Heat Capacity (Btu/ft$^{2}\cdot{}^{o}$F).

U = Wall U-Value (Btu/h/ft$^{2}\cdot{}^{o}$F).

A = (Cooling degree-hours base 80 ^{o}F)/10000 + 2 (^{o}F·h).

B = (Daily Range)/10 + (^{o}F).

Where:

$CP_1 = C_5$

$CP_2 = C_{15}/B^3 + C_{16}/(A^2B^2) + C_{17}$

$CP_3 = C_1/A^3 + C_2B^3 + C_2B^3 + C^3/(A^2 \sqrt{B}) + C_4$

$CP_4 = C_{12}/(A^2B^2) + C_{13}/B^3 + C_{14}$

$CP_5 = C_{18}$

$CP_6 = C_6LN(A) \sqrt{B} + C_7$

LN = Natural Logarithm

$CP_7 = C_{19}/(A^2B^2) + C_{20}/(AB) + C_{21}A^2/ \sqrt{B} + C_{22}$

$CP_8 = C_8/(A^2B^2) + C_9/(AB) + C_{10}A^2/ \sqrt{B} + C_{11}$

The coefficients C1 through C22 are taken from the following table, Table 5B-1.

HEATING EQUATION

$$WC_h \text{ or } H_l = \Sigma\,(HLU_i + HLUO_i + HLXUO_i + HLM_i + HLG_i + HLS_i + HLC_i)$$

Equation 5.5-6

Where:

i = for each orientation

j = for each wall mass construction type for the orientation

$HLU = FO \times U_{ow} \times [\,HU1 \times HDD50 + HU2 \times (VS \times HDD65)^2\,]$

$HLUO = FC \times UOH \times [\,HUO1 \times HDD50 + HUO2 \times HDD65 + HUO3 \times EA \times VS \times HDD65\,]$

$HLXUO = FC \times (\,(1/UOH) \times [\,HXUO1 \times EA \times (VS \times HDD50)^2 + HXUO2 \times EA \times (VS \times HDD65)^2\,] + (1/UOH^2) \times [\,HXUO3 \times EA^2 \times VS \times HDD65\,]\,)$

$HLM = FO_j \times HMC_j \times [\,HM1 + HM2 \times G \times UOH \times HDD65 + HM3 \times G^2 \times EA^2 \times VS \times HDD50 + HM4 \times UOH \times EA \times VS \times HDD65 + HM5 \times UOH \times HDD50 + HM6 \times EA \times (VS \times HDD65)^2 + HM7 \times EA^2 \times VS \times HDD65/UOH\,]$

$$
\begin{array}{llll}
\text{HLG} & = & \text{FC x (G x} & [\ \text{HG1 x HDD65} \\
 & & & +\ \text{HG2 x UOH x HDD65} \\
 & & & +\ \text{HG3 x EA x VS x HDD65} \\
 & & & +\ \text{HG4 x EA}^2\text{ x VS x HDD50}] \\
 & & \text{x G}^2\text{ x} & [\ \text{HG5 x HDD65 + HG6 x EA}^2\text{ x VS x HDD65])}
\end{array}
$$

$$
\begin{array}{llll}
\text{HLS} & = & \text{FC x (EA x} & [\ \text{HS1 x VS x HDD65 + HS2 x (VS x HDD50)}^2\ ] \\
 & & +\ \text{EA}^2\text{ x} & [\ \text{HS3 x VS x HDD50 + HS4 x VS x HDD65])}
\end{array}
$$

$$
\begin{array}{llll}
\text{HLC} & = & \text{FC x} & [\ \text{HC1 + HC2 x HDD65 + HC3 x HDD65}^2 \\
 & & & +\ \text{HC4 x VS}^2\text{ + HC5 x VS x HDD50} \\
 & & & +\ \text{HC6 x VS x HDD65} \\
 & & & +\ \text{HC7 x (VS x HDD50)}^2\ ]
\end{array}
$$

NOTE: The coefficients for various orientations in the equations listed above are found in Table 5B-4. If HC_h or H_1 is less than 0.0, HC_h or H_1 is set equal to 0.0.

Where:

Climate Data

HDD50 = Heating degree-days base 50 °F.

HDD65 = Heating degree-days base 65 °F.

VS = Annual average daily incident solar energy on facade under consideration, Btu/ft^2-day.

Building Data

FC = Wall area (opaque and glazed) of zone under consideration divided by total wall area (opaque and glazed) of all zones.

FO = Opaque wall area of zone under consideration divided by total wall area (opaque and glazed) of all zones. If multiple mass constructions are present, the FO_j is calculated for each and used to form the area weighted mass correction.

U_{OW} = Area average U-value of opaque walls (including those of mass construction) in zone under consideration.

UOH = Area average U-value of wall (opaque and glazed, evaluated under heating conditions) in zone under consideration. UOH is equal to UOC.

WWR = Window wall ratio for zone under consideration; defined as fenestration area divided by total wall area (opaque and glazed).

EA = Effective aperature fraction for zone under consideration.

$$EA = WWR \times SC_x \times S_{oh}$$

Equation 5.5-7

Where:

For $0.0 \leq PF \leq 0.5$, from Equation 5.4-1:

For the north orientation:

$$S_{oh} = 1 - 0.3 \times PF$$

Equation 5.5-7a

For the east, south and west orientation:

$$S_{oh} = 1 - 0.986 \times PF + 0.4513 \times PF^2$$

Equation 5.5-8

G = Effective internal gain (W/ft²) for zone under consideration.

$$G = E_p + L_p \times (1 - R_c \times K_d) + O_l$$

Equation 5.5-8

Where:

L_p = Lighting power, from Section 5.5.7.4.

E_p = Equipment power, from Section 5.5.7.5.

O_l = Occupant load adjustment, from Section 5.5.7.6

R_c = The ratio of the electric lights in the space served by the orientation that have automatic controls for daylighting.

K_d = $5.871\ (WWR \times VLT \times S_{oh}) - 13.311\ (WWR \times VLT \times S_{oh})^2$

Equation 5.5-8a

If WWR x VLT x S_{wh} > 0.22, then K_d = 0.667

Where:

WWR = As defined above, but not to exceed a maximum value of 0.65 in Equation 5.5-8a per Section 5.5.7.3.

VLT = Visible light transmittance of the glazing material, as defined in Section 5.5.2.1 including any shading devices present that modify the visible transmittance of the glazing material.

HMC = Mass correction from Equation 5.5-9. If multiple mass constructions are present, each HMC_j is evaluated separately and combined by area weighting. If the U-value of the mass wall is greater than 0.40, then U_{ow} = 0.4 shall be used to calculate the HMC. If the U-value of the mass wall is less than 0.05, then U_{ow} = 0.05 shall be used to calculate the HMC. If the value of HC is greater than 20, then HC = 20 shall be used to calculate the HMC.

HEATING DELTA LOAD FACTOR EQUATIONS

Equation 5.5-9 is used to predict the Heating Delta Load Factor values.

HMC = Heating Delta Load Factor =

$$\left|1 - e^{-HP_1(HC-1)}\right| \left| HP_2 + HP_3U - \frac{HP_4}{1 + (HP_5 + HP_6U)e^{-(HP_7+HP_8U^2)(HC-1)}} \right| \frac{1.0}{0.7}$$

Equation 5.5-9

Where:

HC = Wall Heat Capacity (Btu/ft^{2}-°F)

U = Wall U-Value (Btu/h·ft^{2}-°F)

A = (Heating degree-days base 65 °F/100 + 2 (°F·days)

Where:

$WP_1 = H_6$

$WP_2 = H_{14}LN(A)+H_{15}$

LN = Natural Logarithm

$WP_3 = H_1A^3+H_2A^2+H_3/\sqrt{A} + H_4\sqrt{A} + H_5$

$WP4 = H_{11}A^2+H_{12}/A^2+H_{13}$

$WP_5 = H_{16}$

$WP_6 = H_7A+H_8$

$WP_7 = H_{17}/A^3+H_{18}$

$WP_8 = H_9/A^3+H_{10}$

The coefficients H1 through H18 are taken from the following table, Table 58-3.

5B.2 Determining Heating and Cooling Criteria Using Equations in Section 5B.1

To determine the wall thermal criteria for a building design, the following inputs to the equations in Section 5B.1 shall be used.

(1) **Aspect Ratio.** An aspect ratio of 2:1 with longer dimensions facing east and west.

(2) **Shading.** No use of external shading projections or screens.

(3) **Daylight Controls.** No use of automatic daylight controls for the lighting system.

(4) **Internal Gain (G).** The sum of the lighting power density (L_p), the equipment power density (E_p) and the occupant load adjustment (O_l), or 3.0 W/ft^2, whichever is smaller, shall be used. In determining L_p, the value of R_c and VLT shall be set equal to 0.0 in Equations 5.5-4 and 5.5-8.

(5) **Wall Area Factor, Opaque and Glazed (FC).** The combined opaque and glazed area for the orientation for the building design, divided by the total wall area (opaque and glazed) of all orientations, shall be used. Note that if one changes the wall area or floor area in a zone, this changes the geometry of the building. The criteria and compliance values will change for all zones because both values for each zone are weighted by the relative size of that zone.

(6) **Window Wall Ratio (WWR).** The smaller of the values of WWR_c and WWR_h determined from (a) and (b) below shall be used.

(a) Using the value for internal gain (G) determined in (4) above, the WWR_c for cooling by interpolation of the results of (a) and (b) below, shall be determined using Equation 5.5-10:

Where: WWR_{g0} is the window to wall ratio at 0.0 W/ft^2 internal load ($G = 0.0$ W/ft^2).

WWR_{g30} is the window to wall ratio at 3.0 W/ft^2 internal load ($G = 3.0$ W/ft^2).

$$WWR_c = WWR_{g0} - (G / 3.0) \times (WWR_{g0} - WWR_{g30})$$

Equation 5.5-10

For $G = 0.0$:

If $CDD50 \times VSEW < 8{,}000{,}000$, then Equation 5.5-11 shall be used.

$$WWR_{g0} = 0.48 - (\ CDD50 \times VSEW \times 1.625 \times 10^{-8}\ )$$

Equation 5.5-11

If $CDD50 \times VSEW \geq 8{,}000{,}000$, then Equation 5.5-12 be used:

$$WWR_{g0} = 0.34$$

Equation 5.5-12

For $G = 3.0$:

If $CDD50 \times VSEW < 8{,}000{,}000$, then Equation 5.5-13 shall be used:

$$WWR_{g30} = 0.28 - (\ CDD50 \times VSEW \times 5.0 \times 10^{-9}\ )$$

Equation 5.5-13

If CDD50 x VSEW ≥ 8,000,000, then Equation 5.5-16 shall be used:

$$WWR_{g30} = 0.24$$

Equation 5.5-14

(b) The WWR_h for heating shall be determined using Equation 5.5-15 or Equation 5.5-16.

If HDD65 < 4000, then Equation 5.5-15 shall be used:

$$WRR_h = 0.4 - (HDD65 \times 2.5 \times 10^{-5})$$

Equation 5.5-15

If HDD65 ≥ 4000, then Equation 5.5-16 shall be used:

$$WRR_h = 0.3$$

Equation 5.5 16

(7) **Opaque Wall Area Factor (FO).** The value of FO shall be determined from Equation 5.5-17.

$$FO = FC \times (1 - WWR)$$

Equation 5.5-17

(8) **Shading Coefficient (SC_x).** The value of SC_x shall be determined from (a) or (b) below, or as shown in Figure 5B-3.

(a) If the heating degree-days base 65 °F for the building location is ≤ to 3000, either Equation 5.5-18 or Equation 5.5-19 shall be used:

If CDD50 x VSEW < 4,000,000, then Equation 5.5-18 shall be used:

$$SC_x = 0.85 - (CDD50 \times VSEW \times 8.75 \times 10^{-8})$$

Equation 5.5-18

If CDD50 x VSEW $\geq$ 4,000,000, then Equation 5.5-19 shall be used:

$$SC_x = 0.5$$

Equation 5.5-19

(l) If the heating degree days base 65 °F for the building location is > 3000, either Equation 5.5-20 or Equation 5.5-21 shall be used:

If CDD50 x VSEW < 4,000,000, then Equation 5.5-20 shall be used:

$$SC_x = 0.85 - (CDD50 \times VSEW \times 1.25 \times 10^{-7})$$

Equation 5.5-20

If CDD50 x VSEW $\geq$ 4,000,000, then Equation 5.5-21 shall be used:

$$SC_x = 0.35$$

Equation 5.5-21

(9) External Shading Projection (S_{eh}). The value of S_{eh} shall be set equal to 0.0.

(10) Opaque Wall U-Value (U_{ow}). The value of U_{ow} shall be determined from either Equation 5.5-22 or Equation 5.5-23, as shown in Figure 5B-4.

If HDD65 < 196, then Equation 5.5-22 shall be used:

$$U_{ow} = 1.0$$

Equation 5.5-22

If HDD65 ≥ 196, then Equation 5.5-23 shall be used:

$$U_{ow} = 42.787 \times HDD65^{(-0.712)}$$

Equation 5.5-23

(11) **Heat Capacity of Opaque Wall (HC).** The value of HC shall be set equal to 1.0.

(12) **Fenestration Assembly U-Value (U_{of}).** The value of U_{of} shall be determined from either Equation 5.5-24, 5.5-25, or 5.5-26; or as shown in Figure 5B-5.

If HDD65 < 3000, then Equation 5.5-24 shall be used:

$$U_{of} = 1.15$$

Equation 5.5-24

If HDD ≥ 3000 and HDD65 < 7500, then Equation 5.5-25 shall be used:

$$U_{of} = 0.81 - [(HDD65 - 3000) \times 8.0 \times 10^{-5}]$$

If HDD ≥ 7500, then Equation 5.5-26 shall be used:

$$U_{of} = 0.45$$

Equation 5.5-26

(13) For all other inputs to the equations in Section 5B.1, the values for the building envelope design under consideration shall be used.

Table 5B-1

COOLING DELTA LOAD COEFFICIENTS

COEFFICIENT LABEL	INSULATION POSITION		
	EXTERIOR	INTEGRAL	INTERIOR
C1	220.724503	139.105667	181.616776
C2	-.056589	-.033991	-.055196
C3	-118.835388	-10.326704	-34.158966
C4	-13.674420	-20.867386	-25.591934
C5	.236381	.283882	.081029
C6	.959588	.305851	1.418998
C7	-.255004	.022622	.432421
C8	-905.677979	-307.943848	-1882.926758
C9	425.191895	80.209610	443.195801
C10	-2.510600	.049955	.430200
C11	-43.387955	-5.989545	-28.285065
C12	-259.723389	-11.396114	-63.562256
C13	-33.975525	.366851	20.844650
C14	20.488235	30.253494	9.817521
C15	-26.209152	8.833706	24.459824
C16	-241.173386	-22.254623	-70.337494
C17	18.897781	29.329697	9.884280
C18	-.353790	-.023878	-.114646
C19	156.305634	63.322754	326.344727
C20	-74.098999	-16.334656	-77.635498
C21	.445363	-.011114	-.074788
C22	7.496696	1.295576	5.204088

TABLE 58-2
COOLING COEFFICIENTS

	NORTH	EAST	SOUTH	WEST
CU1	0.001539	0.003315	0.003153	0.00321
CU2	-0.308548E-07	-0.896618E-07	-0.712993E-07	-0.810530E-07
CU3	0.799493E-13	0.379280E-13	0.183083E-13	0.339810E-13
CU4	-0.079647	0.163114	0.286458	0.11178
CM1	0.32314	0.515262	0.71477	0.752643
CM2	0.153060E-05	0.138197E-05	0.161630E-05	0.142228E-05
CM3	-0.204322E-05	-0.160240E-05	-0.211063E-05	-0.197938E-05
CM4	-0.753665E-06	-0.767849E-06	-0.664430E-06	-0.740067E-06
CM5	-0.100472E-05	0	0.801057E-05	0.315193E-05
CM6	0.366708E-04	0.356503E-04	0.448106E-04	0.296012E-04
CM7	-0.673045E-04	-0.640938E-04	-0.000119	-0.766719E-04
CM8	-0.238335E-07	-0.472534E-07	-0.497469E-07	0
CUO1	-0.651094E-05	-0.838669E-05	-0.888996E-05	-0.756465E-05
CUO2	-1.040207	-1.507235	-1.512625	-1.238545
CUO3	-0.438254E-05	-0.278828E-05	-0.231352E-05	-0.412567E-05
CUO4	0.126580E-04	0.809874E-05	0.736219E-05	0.106712E-04
CXUO1	0.103744E-05	0.119338E-05	0.118588E-05	0.123251E-05
CXUO2	-0.132180E-12	-0.134656E-12	-0.116252E-12	-0.130002E-12
CXUO3	0.275554E-04	0.202621E-04	0.202365E-04	0.236964E-04
CXUO4	0.974090E-07	0.117514E-06	0.939207E-07	0.136276E-06
CXUO5	-0.118247E-04	-0.909694E-05	-0.909192E-05	-0.111077E-04
CG1	0.891286	0.583388	0.393756	0.948654
CG2	0.001479	0.001931	0.002081	0.001662
CG3	-0.552042E-12	-0.282139E-12	-0.284766E-12	-0.455720E-12
CG4	0.252311E-05	0.370821E-05	0.430536E-05	0.591511E-05
CG5	-0.001151	-0.001745	-0.001864	-0.00153
CG6	0.195243E-11	0	-0.296055E-11	0.316358E-11
CG7	-0.835805E-11	0.101089E-10	0.330027E-10	0
CG8	0.141022E-05	0.753875E-06	0.713300E-06	0.970752E-06
CG9	-0.238887E-05	-0.164961E-05	-0.163927E-05	-0.197363E-05
CS1	46.9871	33.9683	18.32016	29.3089
CS2	0.348091E-04	0.374118E-04	0.340490E-04	0.502498E-04
CS3	0	0	0.271313E-11	0
CS4	-0.166409E-04	0.694779E-05	-0.282181E-04	-0.277158E-04
CS5	0.842765E-11	0	-0.304677E-11	0.291137E-11
CS6	-56.5446	0	26.9954	14.9771
CS7	-0.134764E-10	-0.588097E-11	-0.650089E-11	-0.789218E-11

TABLE 5b-2 (Continued)
COOLING COEFFICIENTS

	NORTH	EAST	SOUTH	WEST
CC1	0.002747	0	0.010349	0.001865
CC2	0	0.318928E-06	-0.304413E-06	0
CC3	-0.000348	0.000319	0.00024	0.000565
CC4	0.122123E-07	-0.775318E-07	-0.271443E-07	-0.544380E-07
CC5	0.012112	0.011894	0.013248	0.009236
CC6	0.104027E-11	-0.622661E-12	-0.205178E-11	0
CC7	-0.124013E-04	-0.706280E-05	-0.165377E-04	-0.602685E-05
CC8	0	0	0.820869E-12	0
CC9	-0.375797E-13	0.606235E-13	0.197598E-13	0.389425E-13
CC10	0.030056	0.023121	0.0265	0.01704
CC11	0	0	-0.271026	-0.244274
CC12	0.002138	0.001103	0.006368	0.007323
CC13	-12.8674	-13.16522	-18.271	-10.1285

Table 5B-3
HEATING DELTA LOAD COEFFICIENTS

COEFFICIENT LABEL	INSULATION POSITION		
	EXTERIOR	INTEGRAL	INTERIOR
H1	.000006	.000007	.000006
H2	-.001537	-.001799	-.001492
H3	13.388575	15.116148	19.631360
H4	1.933217	2.105596	1.457923
H5	-11.896660	-13.305299	-15.562034
H6	.464317	.183966	.071887
H7	.009447	.025504	.026392
H8	-.099954	.045871	.775432
H9	-1223.396240	-622.080078	.200792
H10	-.945353	-.519158	-.637875
H11	-.000067	-.000069	-.000007
H12	3.858493	4.137914	2.424339
H13	7.582887	6.238024	7.980392
H14	-.777369	-.771123	-.169907
H15	9.014718	7.722863	8.585447
H16	.200680	.208271	-.038589
H17	206.638214	105.984894	3.139744
H18	.257293	.198297	.186262

Table 5B-4

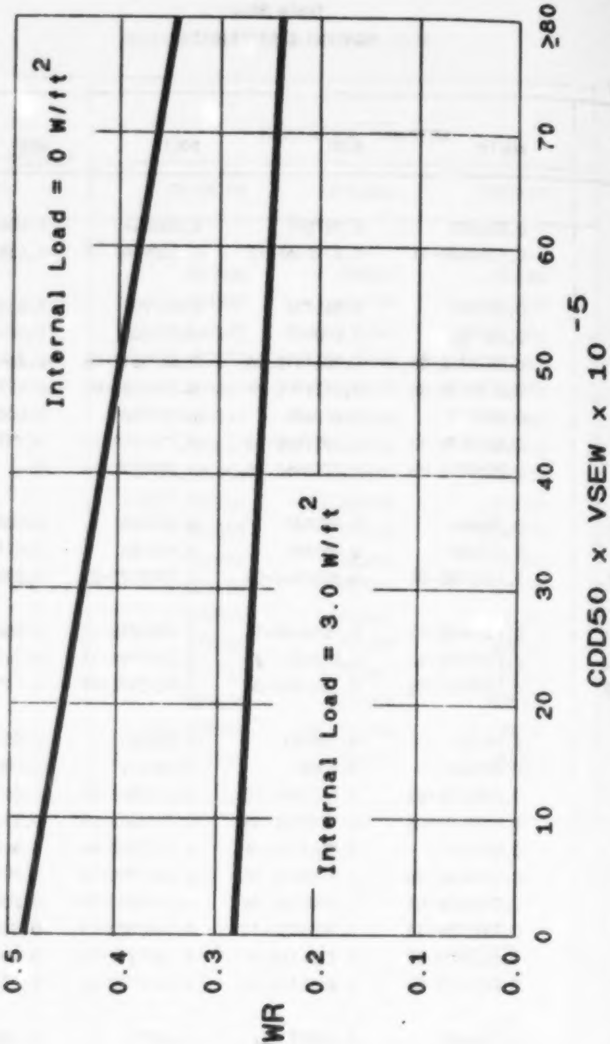
HEATING COEFFICIENTS

	NORTH	EAST	SOUTH	WEST
HU1	0.006203	0.007691	0.006044	0.006672
HU2	-0.135868E-11	-0.571616E-12	-0.268998E-12	-0.435663E-12
HW1	0.531005	0.545732	0.837901	0.616936
HW2	0.000152	0.000107	0.000208	0.00015
HW3	-0.531826E-06	-0.106191E-06	-0.682531E-06	-0.264566E-06
HW4	-0.773815E-06	-0.147870E-05	0.211938E-05	-0.457827E-06
HW5	-0.000712	-0.000484	-0.001042	-0.000625
HW6	0.334859E-12	0.495762E-13	0.770190E-13	0.737105E-13
HW7	0.239071E-06	0.275045E-06	-0.389887E-06	0
HUO1	0.004943	0.008683	0.009028	0.008566
HUO2	0.013686	0.011055	0.010156	0.01146
HUO3	-0.110178E-04	-0.868956E-05	-0.732317E-05	-0.898665E-05
HWUO1	0.126940E-11	0.785644E-13	-0.282023E-12	0.304904E-13
HWUO2	-0.730582E-12	-0.810900E-13	0.745599E-13	-0.747184E-13
HWUO3	0.197090E-06	0.194026E-06	0.987587E-07	0.195776E-06
HG1	-0.001051	-0.000983	-0.000981	-0.000948
HG2	-0.001063	-0.00093	-0.000815	-0.000975
HG3	0.299013E-05	0.262269E-05	0.241880E-05	0.249976E-05
HG4	0.749049E-06	-0.111056E-05	-0.216687E-05	-0.856049E-06
HG5	0.000109	0.934310E-04	0.975523E-04	0.862389E-04
HG6	-0.555914E-06	-0.315801E-06	-0.260999E-06	-0.291334E-06
HS1	-0.218248E-04	-0.209216E-04	-0.210885E-04	-0.202049E-04
HS2	0.339179E-11	0.190500E-11	0.148388E-11	0.218215E-11
HS3	-0.653253E-05	-0.223413E-04	-0.184726E-04	-0.240488E-04
HS4	0.223087E-04	0.241331E-04	0.245412E-04	0.230538E-04
HC1	-0.106468	-5.19297	-3.66743	-5.29681
HC2	0.00729	0.007684	0.007175	0.007672
HC3	-0.297600E-06	-0.307837E-06	-0.264192E-06	-0.307127E-06
HC4	0.201569E-05	0.630350E-05	0.332112E-05	0.643491E-05
HC5	0.129061E-04	0.477552E-05	0.325089E-05	0.483233E-05
HC6	-0.128594E-04	-0.618539E-05	-0.463086E-05	-0.625101E-05
HC7	0.275861E-11	0.820051E-12	0.438148E-12	0.809106E-12

Figure 5B-1

Maximum Window to Wall Ratio

Cooling



Note: use linear interpolation for internal loads 0 < W/ft^2 < 3.0

Figure 5B-2

Maximum Window to Wall Ratio

Heating

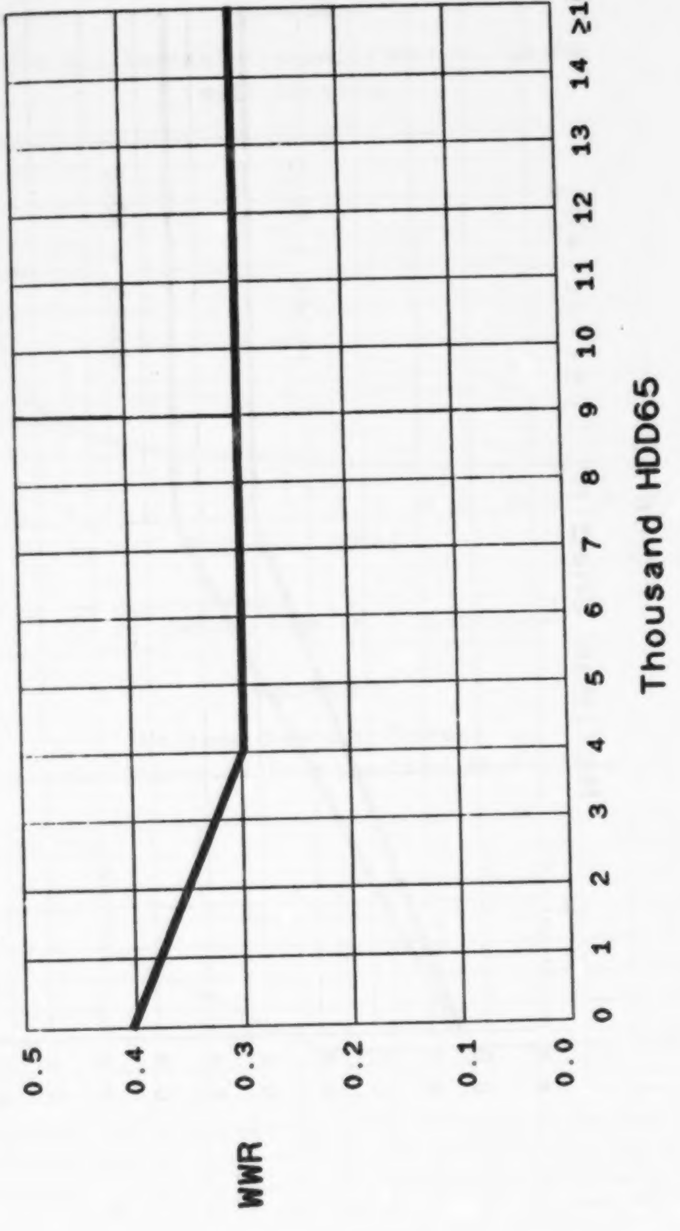


Figure 5B-3

Maximum Shading Coefficient

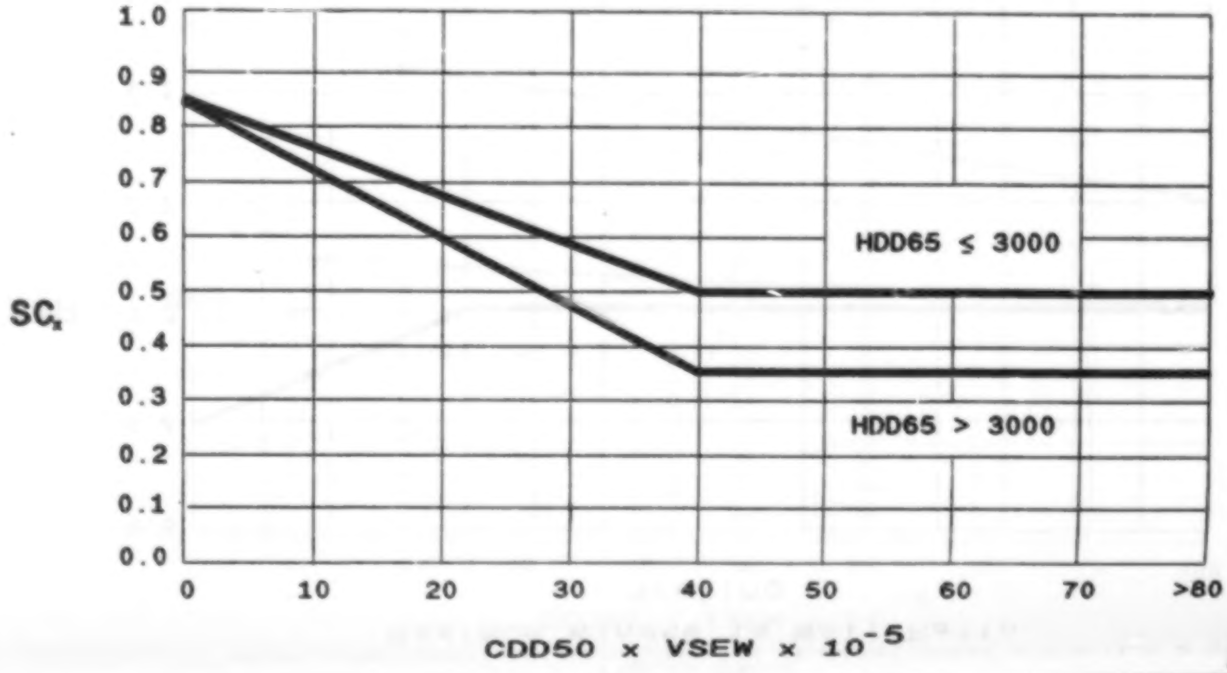
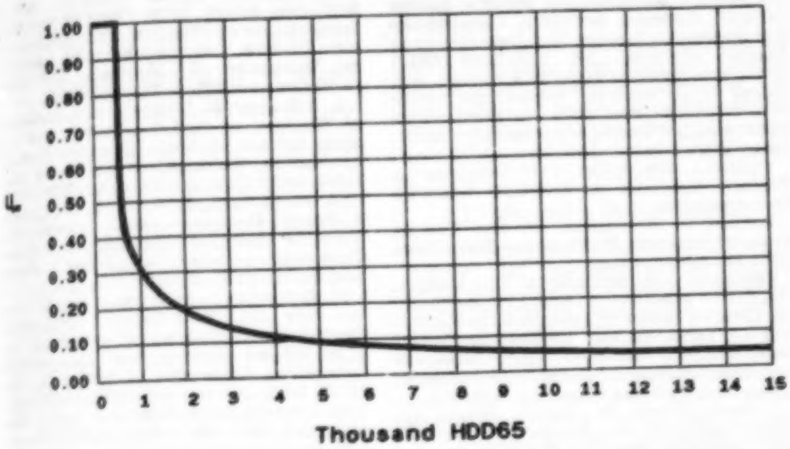


Figure 5B-4

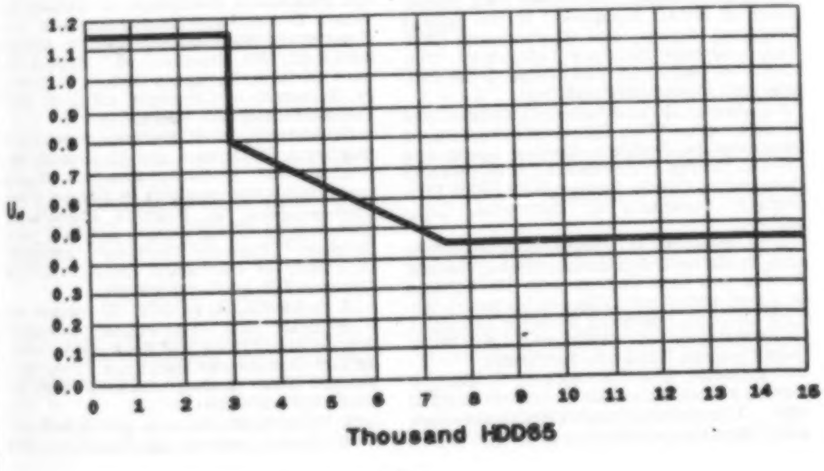
Overall Thermal Transmittance of Opaque Wall Sections



Note: for HDD65 < 196, U_{ow} = 1.0
for 196 ≤ HDD65 ≤ 15000, $U_{ow} = 42.787/\text{HDD65}^{0.712}$

Figure 5B-5

Maximum Overall Thermal Transmittance of Fenestration Assemblies



ATTACHMENT 5C TO 435.105
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Volume 2: Description of the Development Process; Appendix A: Envelope Research Documentation.

Volume 3: Description of the Testing Process; Appendix B: Envelope Compliance Code Documentation.

Volume 4: Documentation of Test Results: (Each in 3 volumes): A: Small Office Building (Branch Bank); B: Medium Office Building; C: Large Office Building; D: Retail Store (Anchor Store); E: Strip Store; F: Apartment House; G: Hotel; H: Warehouse; I: Assembly Building (Church); J: School.

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§ 435.106 Electric power and distribution.

6.1 General

6.1.1 This section contains minimum requirements for all building electrical systems, except required emergency systems.

6.1.2 A building shall be considered in compliance with this section if the minimum requirements of Section 6.3 are met.

6.2 Principles of Design

6.2.1 Electric Distribution Systems

6.2.1.1 Transformers and generating units shall be sized as close as possible to the actual anticipated load (i.e., oversizing is to be avoided so that fixed thermal losses are minimized).

6.2.1.2 Distribution of electric power at the highest practical voltage and load selection at the maximum power factor consistent with safety shall be considered. The use of distribution system transformers shall be minimized.

6.2.1.3 Tenant submetering can be one of the most cost-effective energy conservation measures available. A large portion of the energy use in tenant facilities occurs simply because there is no economic incentive to conserve.

6.3 Minimum Requirements

6.3.1 Electrical Distribution System

6.3.1.1 All commercial or multifamily high rise residential buildings, having designed connected electric service over 250 kVA, shall have electrical energy consumption check metered on the basis of usage category or tenant occupancy, depending on conditions defined below. For buildings that are occupied by multiple tenants, the metering shall be per tenant, if the tenant has a connected load of 100 kVA or more. HVAC and service hot water systems, shared among tenants, need not meet this requirement but shall be separately metered.

6.3.1.2 The electrical power feeders for each facility for which check-metering is required shall be by tenant and shall be subdivided in accordance with the following categories:

6.3.1.2.1 Lighting and receptacle outlets;

6.3.1.2.2 HVAC and service water heating systems and equipment; and

6.3.1.2.3 Special occupant equipment or systems of more than 20 kW, such as elevators, computer rooms, kitchens, printing equipment, and baling presses.

6.3.1.2.4 *Exception to Section 6.3.1.2:*

(a) 10% or less of the loads on a feeder may be from another usage category.

6.3.1.3 The power feeders for each category shall contain portable or permanent submetering prior to or within any primary or secondary distribution panels. Such provisions shall include a separate compartment or panel of adequate size and design to house the necessary voltage and current transformers. An accessible means of attaching clamp-on meters or split-core current transformers shall be provided.

6.3.1.4 The locations of these points of measurement may be central or distributed throughout the building, as appropriate to the layout of the building. A minimum arrangement shall provide a safe method for access to the enclosures through which feeder conductors pass, and have sufficient space to attach clamp-on or split-core current transformers. These enclosures may be separate compartments or combined with electrical cabinets serving another function. Enclosures so furnished shall be identified by available measuring function. A preferred arrangement would include kWh meters and demand registers, or a means to transmit such information to a building energy management control system.

6.3.1.5 In multiple-tenant buildings, where designed connected electrical service is over 250 kVA, each tenant space having a total connected load of more than 100 kVA shall have provision made to permit check-metering of the total tenant load. If the building is served by a common HVAC system, the HVAC loads need not be check metered for each tenant.

6.3.2 Transformers

6.3.2.1 All permanently wired transformers, that are part of the building electrical distribution system, except utility-owned transformers, shall be selected to minimize the combination of no-load, part-load, and full-load losses, without compromising the electrical system operating and reliability requirements.

6.3.2.2 If the total capacity of the transformers exceeds 300 kVA, a calculation of total estimated annual operating costs of the transformer losses shall be made. This calculation shall be based on estimated hours of transformer operation at projected part-load and full-load conditions, and the associated transformer core and coil losses. If appropriate data for projecting this calculation is unavailable, use Form 6.3-1 "Transformer Loss Calculation Estimate" as a basis for making the estimate. The calculations made in accordance with this section shall be used to compare among types of transformers and configurations available to the designer to balance energy costs with necessary operating flexibility, reliability (redundancy), and safety. The projected annual energy costs for the losses of the selected arrangement shall be retained as part of the electrical design documentation.

FORM 6.3-1

TRANSFORMER LOSS CALCULATION ESTIMATE

Transformer Number ______________

Rated Temperature Rise ______________

Cooling Medium ______________

1. kVA	x	2. 0.			=	3. kW x 8760h	=	4. kWh
(Full-load Rating)	x	(No load Loss)			=	(No load kW) x 8760h	=	(Annual no load Loss)
5. h	x	0.1	x	6. kW	=	7. kWh		
(Annual h of operation @ 10% to 50% of load)	x	0.1	x	(Rated Full load coil losses)	=	(Annual part load @ 10% to 50%)		
8. h	x	0.5	x	9. kW	=	10. kWh		
(Annual h of operation @ 50% to 80% of load)	x	0.5	x	(Rated full load coil losses)	=	(Annual part load @ 50% to 80%)		
11. h	x	0.8	x	12. kW	=	13. kWh		
(Annual h of operation @ 80% to 100% of load*)	x	8.0	x	(Rated full load coil losses)	=	(Annual part load @ 80% to 100%)		
				Total	=	14. kWh		
						(Total annual full and part load losses)		
15. kWh	x			16 $ /kWh	=	17. $		
(Total annual full and part load losses)	x			(Average cost of electricity per kWh)	=	(Total annual cost of transformer losses)		

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* If transformers are expected to operate regularly (by means of external cooling) at ratings above full-load kVA, a more precise loss calculation procedure is required.

6.3.3 Electric Motors

6.3.3.1 All permanently wired polyphase motors of 1 hp or more serving the building, shall meet the requirements of this section. Motors expected to operate more than 500 hours per year shall have a minimum acceptable nominal full-load motor efficiency no less than that shown in Table 6.3-1.

6.3.3.1.1 Table 6.3-1 applies to motors having nominal 1200, 1800, or 3600 RPM; with open, drip-proof, or TEFC enclosures. Other motor types are exempted from the minimum efficiency requirements of these standards.

6.3.3.1.2 Motor efficiency ratings shall be based on a statistically valid quality control procedure conforming with *ANSI/IEEE 112-1984, Test Method B (Dynamometer)* using *NEMA MG 1-1987* (MG 1-12.54 and MG 1-12.55) for motors below 500 hp. For motors 500 hp and above, *ANSI/IEEE 112-1984, Test Method B or Method F* (Equivalent Circuit Calculation), shall be used.

6.3.3.1.3 Values listed in Table 6.3-1 are nominal efficiencies. Minimum motor efficiencies shall not be less than the corresponding values provided in *NEMA MG 1-12.54*.

TABLE 6.3-1

MINIMUM ACCEPTABLE FULL-LOAD MOTOR EFFICIENCIES FOR SINGLE SPEED POLYPHASE MOTORS[1]

HORSEPOWER	MINIMUM RATES EFFICIENCY PERCENT
1-4	78.5
5-9	84.0
10-19	85.5
20-49	88.5
50-99	90.2
100-124	91.7
125 and above	92.4

[1] Motors operating more than 750 hours per year are likely to be cost-effective with efficiencies greater than those listed. The more efficient motors are classified by most manufacturers as "high-efficiency," and are presently available for common applications with typical nominal efficiencies of: 5hp, 89.5%; 10hp, 91.0%; 50hp, 94.1%; 100hp, 95.1%; 200hp, 96.2%. Guidance for evaluating the cost effectiveness of high efficiency motor applications is given in NEMA MG 10-83 (nema).

6.3.3.1.4 Motor efficiency shall be tested using a statistically valid quality control procedure conforming with the *IEEE 112A, Test Method B (1978)* (Dynmometer) fan motors E below 500 hp, or *Test Method F (1978)* (Equivalent Circuit Calculation) based on no-load measurements for motors 500 hp and larger.

6.3.3.2 Motor nameplates shall list the minimum and the nominal full-load motor efficiencies and the full-load power factor.

6.3.3.3 Full-load motor power factor for three-phase motors can be calculated from nameplate data by Equation 6.3-1:

% Power Factor=(hp × 746 × 100)/(nominal efficiency × full-load amps × rated voltage $\times 3^{0.5}$).

Equation 6.3-1

6.3.3.4 Motor horsepower rating shall not exceed 125% of the calculated maximum load being served, or the next larger standard motor size if a standard rating does not fall within this range.

6.3.4 Operation and Maintenance of Electrical Systems

6.3.4.1 The designer shall specify that building owners be provided with written information that provides basic data relating to the design, operation, and maintenance of the electrical distribution system for the building. This shall include:

6.3.4.1.1 a single-line diagram of the "as-built" building electrical system;

6.3.4.1.2 schematic diagrams of electrical control systems (other than HVAC, covered elsewhere);

6.3.4.1.3 manufacturers' operating and maintenance manuals on active electrical equipment; and

6.3.4.1.4 the Transformer Loss Calculation Estimate if required by Section 6.3.2.2.

§ 435.107 Heating, Ventilation, and Air-Conditioning (HVAC) systems.

7.1 General

7.1.1 This section contains minimum and prescriptive requirements for the design of HVAC systems. It is recommended that the designer evaluate other energy conservation measures that may be applicable to the proposed design.

7.1.2 A building shall be considered in compliance with this section if the following conditions are met:

7.1.2.1 The minimum requirements of Section 7.3 are met; and

7.1.2.2 The HVAC system design complies with the prescriptive criteria of section 7.4. For the design of HVAC systems that incorporate innovative or alternate design strategies, the compliance paths set forth in Section 11.0 or 12.0 should be used.

7.2 Principles of Design

7.2.1 Control of Equipment Loads

7.2.1.1 The thermal impact of equipment and appliances shall be minimized by use of hoods, radiation shields, or other confining techniques, and by use of controls to assure that such equipment is turned off when not needed. In addition, major heat-generating equipment shall, where practical, be located where it can balance other heat losses. For example, computer centers or kitchen areas could be located in the north or northwest perimeter areas of buildings depending on climate and prevailing wind directions. In addition, heat recovery shall be specifically considered for this equipment.

7.2.2 HVAC System Design

7.2.2.1 Separate HVAC systems shall be considered to serve areas expected to operate on widely differing operating schedules or design conditions. For instance, systems serving office areas should generally be separate from those serving retail areas. When a single system serves a multitenant building, provisions shall be made to shut-off or set-back the heating and cooling to each area independently.

7.2.2.2 Spaces with relatively constant and weather-independent loads may be served with systems separate from those serving perimeter spaces. Areas with special temperature or humidity requirements, such as computer rooms, shall be served by systems separate from those serving areas that require comfort heating and cooling only, alternatively, these areas shall be served by supplementary or auxiliary systems.

7.2.2.3 The supply of zone cooling and heating shall be sequenced to prevent the simultaneous operation of heating and cooling systems for same space. Where this is not possible due to ventilation or air circulation requirements, air quantities shall be reduced as much as possible before reheating, recooling, or mixing hot and cold air streams. Finally, supply air temperature shall be reset to extend economizer operations and to reduce reheat, recool, or mixing losses.

7.2.2.4 Systems serving areas with significant internal heat gains (lighting, equipment, and people), especially interior zones with little or no exposure to outside air, shall be designed to take advantage of mild or cool weather conditions to reduce cooling energy if heat recovery systems are not used. These systems, called air or water economizers, shall be designed to provide a partial reduction in cooling loads even when mechanical cooling must be used to provide the remainder of the load. Economizer controls shall be integrated with the mechanical cooling (leaving air temperature) controls so that mechanical cooling is only operated when necessary and so supply air is not overcooled to a temperature below the desired supply temperature. The systems and controls shall be designed so that economizer operation does not increase heating energy use. For instance, single fan dual duct or multizone systems that use the same mixed air plenum for both heating and cooling supplies shall not be used.

7.2.2.5 Controls shall be provided to allow systems to operate in an occupied mode and an unoccupied mode. In the occupied mode, controls shall provide for a gradually changing control point as system demands change from cooling to heating. In the unoccupied mode, ventilation and exhaust systems shall be shut off if possible, and comfort heating and cooling systems shall be shut off except to maintain "setback" space conditions. The setback conditions shall be the minimum and maximum levels required to prevent damage to the building or its contents and provide for a reasonable morning pick-up period. Note however that night setback may not conserve energy in buildings with large amounts of thermal mass.

7.2.2.6 In areas where diurnal temperature swings and humidity levels permit, the judicious coupling of air distribution systems and building structural mass may be considered to allow the use of night-time precooling to reduce the use of day-time mechanical cooling.

7.2.2.7 High ventilation, such as in hospital operating rooms, can impose enormous heating and cooling loads on HVAC equipment. In these cases, consideration shall be given to the use of recirculating filtered and cleaned air, rather than 100% outside air, and preheating outside air with solar systems or reclaimed heat from other sources.

7.2.3 Energy Transport Systems

7.2.3.1 Energy shall be transported by the most energy efficient means possible. The following options, are listed in order of efficiency from the (most efficient) lowest energy transport burden to the highest:

7.2.3.1.1 Electric Wire or Fuel Pipe,

7.2.3.1.2 Two-Phase Fluid Transfer (Steam or Refrigerant),

7.2.3.1.3 Single-Phase Liquid Fluid (Water, Glycol, Etc.), and

7.2.3.1.4 Air.

7.2.3.2 The distribution system shall be selected to complement other system parameters such as control strategies, storage capabilities, and conversion and utilization system efficiencies.

7.2.3.3 Steam Systems

7.2.3.3.1 Provisions for seasonal or "non-use time" shutdown shall be incorporated.

7.2.3.3.2 The venting of steam and ingestion of air shall be minimized with the design directed toward full vapor performance.

7.2.3.3.3 Subcooling shall generally be prevented.

7.2.3.3.4 Condensate shall be returned to boilers or source devices at the highest possible temperature.

7.2.3.4 Water Systems

7.2.3.4.1 Design flow quantity shall be minimized by designing for the maximum practical temperature differential.

7.2.3.4.2 Flow quantity shall be varied with load where possible.

7.2.3.4.3 Designs shall be for lowest practical pressure rise (or drop).

7.2.3.4.4 Operating and idle control modes shall be provided.

7.2.3.4.5 When locating equipment, the critical pressure path shall be identified and the runs sized for minimum practical pressure drop.

7.2.3.5 Air Systems

7.2.3.5.1 Air flow quantity shall be minimized by careful load analysis and an effective distribution system. If the psychometric nature of the application allows, the supply air quantity shall vary with the sensible load (i.e., VAV systems). The fan pressure requirement shall be held to the lowest practical value. Fan pressure shall be avoided as a source for control power.

7.2.3.5.2 Each fan system shall be designed and controlled to reduce mechanical cooling requirements by taking advantage of favorable weather conditions.

7.2.3.5.3 "Normal" and "idle" control modes shall be provided for the fan systems as well as the psychometric systems.

7.2.3.5.4 Duct run distances shall be as short as possible, and the runs on the critical pressure path sized for minimum practical pressure drop.

7.2.4 Radiant Heating

7.2.4.1 Radiant heating systems shall be considered in lieu of convective or all-air heating systems to heat areas which experience infiltration loads in excess of two (2) air changes per hour at design heating conditions.

7.2.4.2 Radiant heating systems should be considered for areas with high ceilings, for spot heating, and for other applications where radiant heating may be more energy efficient than convective or all-air heating systems.

7.2.5 Energy Recovery

7.2.5.1 Systems that recover energy should be considered when rejected fluid is of adequate temperature and a simultaneous need for energy exists for a significant number of operating hours.

7.3 Minimum Requirements

7.3.1 Calculation Procedures

7.3.1.1 Heating and cooling system design loads for the purpose of sizing systems and equipment shall be determined in accordance with the procedures described in the *ASHRAE Handbook, 1985 Fundamentals Volume,* or a similar computation procedure. The design parameters specified in sections 7.3.1.2 through 7.3.1.10 shall be used for calculational purposes only and are not requirements or recommendations for operating setpoints.

7.3.1.2 *Indoor Design Conditions.* Indoor design temperature and humidity conditions for general comfort applications shall be in accordance with the comfort criteria established in *ANSI/ASHRAE Standard 55-1981,* "Thermal Environmental Conditions for Human Occupancy," and/or Chapter 8 of the *ASHRAE Handbook, 1985 Fundamentals Volume,* except that winter humidification and summer dehumidification are not required.

7.3.1.2.1 *Exceptions to Section 7.3.1.2:*

(a) Health care institutions and similar facilities where the indoor conditions may not be appropriate for the health and safety of occupants; and

(b) Where special room temperature and/or humidity conditions are required by a process or procedure, other than comfort, such as rooms used for surgery or data processing.

7.3.1.3 *Outdoor Design Conditions.* Outdoor design conditions shall be selected for listed locations from the *ASHRAE Handbook, 1985 Fundamentals Volume,* from the columns of 99% values for heating design and 2.5% values for cooling design. Local weather data from the National Weather Service of the National Oceanic and Atmospheric Administration based on the same 99% and 2.5% values (or statistically similar annualized values such as 0.2% winter and 0.5% summer) may be used.

7.3.1.3.1 *Exception to Section 7.3.1.3:*

(a) Where necessary to assure the prevention of damage to the building or to material and equipment within the building, the median of annual extremes for heating and 1% column for cooling may be used.

7.3.1.4 *Ventilation.* Outdoor air ventilation rates shall be selected from section 6.1 of *ASHRAE Standard 62-1981,* "Ventilation for Acceptable Indoor Air Quality."

7.3.1.4.1 *Exception to Section 7.3.1.4:*

(a) Outdoor air quantities, exceeding those shown in *ASHRAE Standard 62-1981,* required because of special occupancy or process requirements, source control of air contamination, or local codes.

7.3.1.5 *Infiltration.* Infiltration for heating and cooling design loads shall be calculated by the procedures in the *ASHRAE Handbook, 1985 Fundamen-*

tals Volume, or a similar computation procedure.

7.3.1.6 *Envelope*. Building envelope heating and cooling loads shall be based on envelope characteristics, such as thermal conductance, shading coefficient and air leakage, consistent with the values used in the proposed building design to demonstrate compliance with section 5.0.

7.3.1.7 *Lighting*. Lighting loads shall be based on proposed design lighting levels or power budgets consistent with section 3.0. Lighting may be ignored for heating load calculations.

7.3.1.8 *Other Loads*. Other HVAC system loads, such as those due to people and equipment, shall be based on design data compiled from at least one of the following sources:

7.3.1.8.1 Actual information based on the intended use of the building;

7.3.1.8.2 Published data from manufacturers' technical publications and from technical society publications such as the *ASHRAE Handbook, 1987 HVAC Systems Applications Volume;*

7.3.1.8.3 Alereza, "Estimates of Recommended Heat Gains Due to Commercial Appliances and Equipment," *ASHRAE Transactions 90 (Pt. 2A), 25-28* (1984);

7.3.1.8.4 Default values to be used in determining the design energy budget in section 11.0 or 12.0 taken from Tables 11-2, 11-3, 11-4 and 11-6; and

7.3.1.8.5 Other data based on designer's experience of expected loads and occupancy patterns.

7.3.1.8.6 *Exception to Section 7.3.1.8:*

(a) Internal heat gains may be ignored for heating load calculations.

7.3.1.9 *Safety Factor*. Design loads may, at the designer's option, be increased by as much as 10% to account for unexpected loads or changes in space usage.

7.3.1.10 *Pick-up Loads*. Transient loads such as warm-up or cool-down loads that occur after off-hour setback or shutoff, may be calculated from basic principles, based on the heat capacity of the building and its contents, the degree of setback, and desired recovery time, or may be assumed to be up to 30% for heating and 10% for cooling of the steady-state design loads.

7.3.2 System and Equipment Sizing

7.3.2.1 HVAC systems and equipment shall be sized to provide no more than the space and system loads require, as calculated in accordance with section 7.3.1.

7.3.2.1.1 *Exceptions to Section 7.3.2.1:*

(a) Equipment capacity may exceed the design load if the equipment selected is the smallest size needed to meet the load within available options of equipment;

(b) Equipment whose capacity exceeds the design load may be specified if calculations demonstrate that oversizing can be shown not to increase annual energy use;

(c) Stand-by equipment may be installed if controls and devices are provided that allow stand-by equipment to operate automatically only when the primary equipment is not operating;

(d) Multiple units of the same equipment type, such as multiple chillers and boilers, with combined capacities exceeding the design load may be specified to operate concurrently only if controls are provided that sequence or otherwise optimally control the operation of each unit based on cooling or heating load;

(e) For unitary equipment with both heating and cooling capability, only one function, either the heating or the cooling, need meet the requirements of this subsection. Capacity for the other function shall be, within available equipment options, the smallest size necessary to meet the load; and

(f) For buildings complying with section 11.0 or 12.0, equipment of higher capacity than the design load may be specified if the oversized equipment is modeled in the building energy analysis of the proposed design and the proposed design complies with the standards.

7.3.3 Separate Air Distribution Systems

7.3.3.1 Zones in a building that are expected to operate non-concurrently for 750 or more hours per year shall either be served by separate air distribution systems, or off-hour controls shall be provided in accordance with section 7.3.5.3.

7.3.3.2 Zones with special process temperature and/or humidity requirements shall be served by separate air distribution systems from those serving zones requiring only comfort heating and/or cooling, or supplementary provisions shall be included to allow the primary systems to be specifically controlled for comfort purposes only.

7.3.3.2.1 *Exception to Section 7.3.3.2:*

(a) Zones, requiring comfort heating and/or cooling, that are served by a system primarily used for process temperature and humidity control, need not be served by a separate system if the total supply air to these zones is no more than 25% of the total system supply air, or the zones total conditioned floor area is less than 1000 ft^2.

7.3.3.3 Zones having substantially different heating or cooling load characteristics, such as perimeter zones in contrast to interior zones, shall not be served by a single multiple zone air distribution system.

7.3.4 *Temperature Controls*

7.3.4.1 *System Control.* Each HVAC system shall include at least one temperature control device.

7.3.4.2 *Zone Controls.* The supply of heating and/or cooling energy to each zone shall be controlled by an individual thermostat located within the zone.

7.3.4.2.1 *Exceptions to Section 7.3.4.2:*

(a) Independent perimeter systems may serve multiple zones of the primary/interior system with the following limitations:

(1) The perimeter system shall include at least one thermostatic control zone for each major building exposure having exterior walls facing only one orientation for 50 contiguous feet or more; and

(2) The perimeter system heating and/or cooling supply shall be controlled by thermostat controls located within the zone(s) served by the system; and

(b) A dwelling unit may be considered a single zone.

7.3.4.3 Zone thermostats used to control comfort heating shall be capable of being set, locally or remotely, by adjustment or selection of sensors, down to 55 °F.

7.3.4.4 Zone thermostats used to control comfort cooling shall be capable of being set, locally or remotely, by adjustment or selection of sensors, up to 85 °F.

7.3.4.5 Zone thermostats used to control both heating and cooling shall be capable of providing a temperavure range or dead band of at least 5 °F within which the supply of heating and cooling energy to the zone is shut off or reduced to a minimum.

7.3.4.5.1 *Exceptions to Section 7.3.4.5:*

(a) For buildings complying with Section 11.0 or 12.0, dead band controls are not required if, in the building energy analysis, heating and cooling thermostat setpoints are set to the same value between 70 °F and 75 °F and assumed to be constant throughout the year;

(b) Special occupancy, special usage or construction code requirements where dead band controls are not appropriate, adjustable single setpoint thermostats may be used; and

(c) Thermostats that require manual changeover between heating and cooling modes.

7.3.5 *Off-hour Controls*

7.3.5.1 Each HVAC system shall have automatic control setback and/or shutdown of equipment during periods of non-use or alternate use of the spaces served by the system.

7.3.5.1.1 *Exceptions to Section 7.3.5.1:*

(a) Systems serving areas expected to operate continuously;

(b) Where equipment with a full load demand of 2kW (6826 Btu/h) or less may be controlled by readily accessible manual off-hour controls;

(c) Where setback or shutdown will not result in a decrease in overall building energy use.

7.3.5.2 Outside air supply and/or exhaust systems shall be equipped with motorized or gravity dampers or other means of automatic volume shutoff or reduction during periods of non-use or alternate use of the spaces served by the system.

7.3.5.2.1 *Exceptions to Section 7.3.5.2:*

(a) Individual ventilation systems when design air flow is 3000 cfm or less;

(b) Systems that operate continuously;

(c) When restricted by code, such as at combustion air intakes; or

(d) When gravity and other non-electrical ventilation systems may be controlled by readily accessible manual damper controls.

7.3.5.2.2 Dampers may be required in some climates to prevent equipment damage due to freezing and/or to provide proper warm-up control.

7.3.5.3 Systems that serve areas that operate non-concurrently for 750 or more hours per year shall have isolation devices and controls for shut off or set back of heating and cooling to each zone independently. Isolation is not required for zones expected to operate continuously or expected to be inoperative only when all other zones are inoperative.

7.3.5.3.1 For buildings where occupancy patterns are not known at the time of system design, isolation areas may be predesignated.

7.3.5.3.2 Zones may be grouped into a single isolation area providing the total conditioned floor area does not exceed 25,000 ft^2 per group nor include more than one floor.

7.3.6 Humidity Control

7.3.6.1 If a system maintains specific relative humidities by adding moisture, a humidistat shall be provided.

7.3.6.2 If comfort humidification is provided, the system shall be designed to prevent the use of fossil fuel or electricity to maintain relative humidity in excess of 30%.

7.3.6.3 If comfort dehumidification is provided, the system shall be designed to prevent the use of fossil fuel or electricity to reduce relative humidity below 60%.

7.3.7 Materials and Construction

7.3.7.1 Insulation required by Section 7.3.7.2 and 7.3.7.3 shall be suitably protected from damage. Insulation shall be installed in accordance with the *Midwest Insulation Contractors Association "Commercial and Industrial Insulation Standards,"* 1983.

7.3.7.2 *Piping Insulation.* All HVAC system piping installed to serve buildings and within buildings shall be thermally insulated in accordance with Table 7.3-1.

Table 7.3-1

Minimum Pipe Insulation (in.)[1]

Fluid Design Operating Temperature Range, °F	Insulation Conductivity		Nominal Pipe Diameter (in.)					
	Conductivity Range Btu·in./F·h·ft^2	Mean Rating Temperature °F	Runouts[2] up to 2	1 and less	1-1/4 to 2	2-1/2 to 4	5 & 6	8 and up
Heating Systems (Steam, Steam Condensate, & Hot Water)								
306-450	0.32-0.34	250	1.5	2.5	2.5	3.0	3.5	3.5
251-305	0.29-0.31	200	1.5	2.0	2.5	2.5	3.5	3.5
201-250	0.27-0.30	150	1.0	1.5	1.5	2.0	2.0	3.5
141-200	0.25-0.29	125	0.5	1.5	1.5	1.5	1.5	1.5
105-140	0.24-0.28	100	0.5	1.0	1.0	1.0	1.5	1.5
Domestic and Service Hot Water Systems[3]								
105-140	0.24-0.28	100	0.5	1.0	1.0	1.5	1.5	1.5
Cooling Systems (Chilled Water, Brine, & Refrigerant)[4]								
40-55	0.23-0.27	75	0.5	0.5	0.75	1.0	1.0	1.0
Below 40	0.23-0.27	75	1.0	1.0	1.5	1.5	1.5	1.5

1. For minimum thicknesses of alternative insulation types, see Section 7.3.7.2.2.
2. Runouts to individual terminal units not exceeding 12 ft in length.
3. Applies to recirculating sections of service or domestic hot water systems and first 8 ft from storage tank for non-recirculating systems.
4. The required minimum thicknesses do not consider water vapor transmission and condensation. Additional insulation and/or vapor retarders may be required to limit water vapor transmission and condensation.

7.3.7.2.1 *Exceptions to Section 7.3.7.2:*

(a) For manufacturer installed piping within HVAC equipment tested and rated in accordance with Section 8.3;

(b) For piping conveying fluids at temperatures between 55 °F and 105 °F;

(c) For piping conveying fluids that have not been heated or cooled through the use of fossil fuels or electricity; and

(d) When calculations demonstrate that heat gain and/or heat loss to or from piping without insulation will not increase building energy use.

7.3.7.2.2 *Alternative Insulation Types.* Insulation thicknesses in Table 7.3-1 are based on insulation with thermal conductivities listed in Table 7.3-1 for each fluid operating temperature range, rated in accordance with *ASTM C 335-84*, "Test Method for Steady-State Heat Transfer Properties of Horizontal Pipe Insulations," at the mean temperature listed in the table. For insulating materials having conductivities more than of those shown in the Table 7.3-1 for the applicable fluid operating temperature range and at the mean rating temperature shown, when rounded to the nearest 1/100th Btu/h·°F·ft², the minimum thickness shall be determined in accordance with Equation 7.3-1:

$$T=PR\times[(1+t/PR)^{K/k}-1]$$

Equation 7.3-1

Where:

T=minimum insulation thickness for material with conductivity K, in.

PR=pipe actual outside radius, in.

t=insulation thickness from Table 7.3-1, in.

K=conductivity of alternate material at the mean rating temperature indicated in Table 7.3-1 for the applicable fluid temperature range, Btu·in./h·°F·ft²

k=the lower value of conductivity listed in Table 7.3-1 for the applicable fluid temperature range, Btu·in./h·°F·ft²

7.3.7.3 *Air Handling System Insulation.* All air handling ducts, plenums, and other enclosures installed as part of an HVAC air distribution system shall be thermally insulated in accordance with Table 7.3-2 (This table comes from Section 1005 of the 1985 Uniform Mechanical Code).

Table 7.3-2
Minimum Duct Insulation[1]

Duct Location	Cooling[2]		Heating[3]	
	Annual Cooling Degree Days Base 65 $^{\circ}$F	Insulation R-value[4] ft^2·h·$^{\circ}$F/Btu	Annual Heating Degree Days Base 65 $^{\circ}$F	Insulation R-value[4] ft^2·h·$^{\circ}$F/Btu
Exterior of building	below 500	3.3	below 1500	3.3
	500 to 1150	5.0	1500 to 4500	5.0
	1151 to 2000	6.5	4501 to 7500	6.5
	above 2000	8.0	above 7500	8.0
Inside of building envelope or in unconditioned spaces[7]				
TD[5] <=15		None Requ'd		None Req'd
40 >= TD[5] > 15	----	3.3	----	3.3
TD[5] > 40	----	5.0[6]	----	5.0[6]

1. Insulation R-values shown are for the insulation as installed and do not include film resistance. The required minimum thicknesses do not consider water vapor transmission and condensation. Additional insulation and/or vapor retarders may be required to limit vapor transmission and condensation. For ducts which are designed to convey both heated and cooled air, duct insulation shall be as required by the most restrictive condition. Where exterior walls are used as plenum walls, wall insulation shall be as required by the most restrictive condition of this Section or Section 5.0.
2. Cooling ducts are those designed to convey mechanically heated air or return ducts in such systems.
3. Heating ducts are those designed to convey mechanically heated air or return ducts in such systems.
4. Insulation resistance measured on a horizontal plane in accordance with ASTM C518-85 at a mean temperature of 75 $^{\circ}$F at the installed insulation thickness.
5. TD is defined as the temperature difference at design conditions (see Section 7.3.1) between the space within which the duct is located and the design air temperature in the duct.
6. Insulation resistance for runnouts to terminal devices less than 10 feet in length need not exceed 3.3 ft^2·h·F/Btu.
7. Unconditioned spaces include crawl spaces and attics.

7.3.7.3.1 *Exception to section 7.3.7.3:* Duct insulation is not required in any of the following cases:

(a) Manufacturer installed plenums, casings or ductwork furnished as a part of HVAC equipment tested and rated in accordance with section 8.3; and

(b) When calculations demonstrate that heat gain and/or heat loss to or from ducts without insulation will not increase building energy use.

7.3.7.4 *Duct Construction.* All air handling ductwork and plenums shall be constructed, erected and tested in accordance with the following Sheet Metal and Air Conditioning Contractors National Association (SMACNA) Standards: *HVAC Duct System Design Manual,* 1986; *HVAC Duct Leakage Test Manual,* 1985; and *Fibrous Glass Construction Standards,* 5th edition, 1979.

7.3.7.4.1 Ductwork designed to operate at static pressure differences greater than 3 in. W.C. shall be leak tested and conform with the following requirements of the *HVAC Duct Leakage Manual, 1985:* Test procedures shall be in accordance with those outlined in section 5.0 of the manual, or equivalent; test reports shall be provided in accordance with section 6.0 of the manual, or equivalent; the tested duct leakage class at a test pressure equal to the design duct pressure class rating shall be equal to or less than leakage class 6 as defined in section 4.1 of the manual. Leakage testing may be limited to representative sections of the duct system but in no case shall such tested sections include less than 25% of the total installed duct area for the designated pressure class.

7.3.7.4.2 Where supply ductwork designed to operate at static pressure differences from ¼ in. to 2 in. W.C. are located outside of the conditioned space, including return plenums, joints shall be sealed in accordance with Seal Class C, as defined in the SMACNA manuals referenced above. Pressure sensitive tape shall not be used as the primary sealant for such ducts designed to operate at 1 in. W.C. pressure difference or greater.

7.3.8 Completion Requirements

7.3.8.1 An operating and maintenance manual shall be provided to the building owner. The manual shall include basic data relating to the operation and maintenance of HVAC systems and equipment. Required routine maintenance actions shall be clearly identified. Where applicable, HVAC controls information such as diagrams, schematics, control sequence descriptions, and maintenance and calibration information shall be included.

7.3.8.2 Air system balancing shall be accomplished in a manner to minimize throttling losses and then fan speed shall be adjusted to meet design flow conditions. Balancing procedures shall be in accordance with those established by the National Environmental Balancing Bureau (NEBB), the Association of Air Balancing Council (AABC), or similar procedures.

7.3.8.2.1 *Exception to section 7.3.8.2:*

(a) Damper throttling may be used for air system balancing with fan motors of 1 hp or less, or if throttling results in no greater than ½ hp fan horsepower draw above that required if the fan speed were adjusted.

7.3.8.3 Hydronic system balancing shall be accomplished in a manner to minimize throttling losses and then the pump impeller shall be trimmed or pump speed shall be adjusted to meet design flow conditions.

7.3.8.3.1 *Exceptions to section 7.3.8.3:* Valve throttling may be used for hydronic systems balancing under any of the following conditions:

(a) Pumps with pump motors of 10 hp and less;

(b) If throttling results in pump horsepower draw no greater than 3 hp above that required if the impeller were trimmed;

(c) To reserve additional pump pressure capability in open circuit piping systems subject to fouling. Valve throttling pressure drop shall not exceed that expected for future fouling; or

(d) Where it can be shown that throttling will not increase overall building energy use.

7.3.8.4 HVAC control systems shall be tested to assure that control elements are calibrated, adjusted, and in proper working condition.

7.4 *Heating, Ventilation and Air-Conditioning (HVAC) Systems—Prescriptive Compliance Alternative*

7.4.1 Zone Controls

7.4.1.1 Zone thermostatic and humidistatic controls shall be capable of operating in sequence, the supply of heating and cooling energy to the zone. The controls shall prevent:

7.4.1.1.1 Reheating (heating air that is cooler than system mixed air);

7.4.1.1.2 Recooling (cooling air that is warmer than system mixed air);

7.4.1.1.3 Mixing or the simultaneous supply of air that has been previously mechanically heated and air that has been previously cooled, either by mechanical refrigeration or by economizer systems; and

7.4.1.1.4 Other simultaneous operation of heating and cooling systems to one zone.

7.4.1.2 *Exceptions to Section 7.4.1.1:*

7.4.1.2.1 Variable air volume systems that, during periods of occupancy, are designed to reduce the air supply to each zone to a minimum before reheating, recooling, or mixing during periods of occupancy. The minimum volume setting shall be no greater than the larger of the following:

(a) 30% of the peak supply volume;

(b) The minimum volume required to meet the ventilation requirements of Section 7.3.1.4; and

(c) 0.4 cfm/ft^2 of conditioned zone area. In addition, supply air temperatures shall be automatically reset based on representative building loads or outside air temperature by at least 25% of the difference between the design supply air and room air temperature. Zones expected to experience relatively constant loads, such as interior zones, shall be designed for the fully reset supply temperature. Supply air reset control is not required if calculations demonstrate that it increases overall building energy use;

7.4.1.2.2 Zones where special pressurization relationships or cross-contamination requirements are such that variable air volume systems are impractical, such as some areas of hospitals and laboratories. In these cases, systems shall include automatic supply air reset controls in accordance with section 7.4.1.2.1 above;

7.4.1.2.3 At least 75% of the energy for reheating or providing warm air in mixing systems is provided from site-recovered energy that would otherwise be wasted, or from non-depletable energy sources;

7.4.1.2.4 Zones where specific humidity levels are required to satisfy process needs, such as computer rooms and museums (see section 7.3.3.2); and

7.4.1.2.5 Zones with a peak supply air quantity of 300 cfm or less.

7.4.2 Economizer Controls

7.4.2.1 Each fan system shall be designed to take advantage of favorable weather conditions to reduce mechanical cooling requirements. The system shall include either of the following:

7.4.2.1.1 A temperature or enthalpy air economizer system that is capable of automatically modulating outside air and return air dampers to provide up to 85% outside air for cooling; or

7.4.2.1.2 A water economizer system that is capable of cooling supply air by direct and/or indirect evaporation. The system shall be designed and controlled to be able to provide 100% of the system cooling load at outside air temperatures of 50 °F dry-bulb/45 °F wet-bulb and below. Each economizer system shall be capable of providing partial cooling even when additional mechanical cooling is required to meet the remainder of the cooling load.

7.4.2.1.3 *Exceptions to Section 7.4.2.1:*

(a) individual fan/cooling units with supply capacity of less than 3,000 cfm or a total cooling capacity less than 90,000 Btu/h. The total capacity of such units per building complying by this exception shall not exceed 600,000 Btu/h per building or 10% of the total installed cooling capacity, whichever is larger;

(b) Systems with air or evaporatively cooled condensers and for which one of the following is true:

(1) The system is located where the quality of the air, as defined in *ASHRAE Standard 62-1981*, is so poor as to require extensive treatment of the air, and

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(2) Calculations indicate that the use of outdoor air cooling affects the operation of other systems, such as humidification, dehumidification, and supermarket refrigeration systems and will increase overall building energy use;

(c) Calculations demonstrate that the overall building energy use for alternative designs, such as internal/external zone heat recovery systems, are less than those for an economizer system;

(d) The system is located where the outdoor summer wet-bulb design condition (2.5% occurrence, *ASHRAE Handbook, 1985 Fundamentals Volume*) is more than 72 °F and annual HDD65 are less than 2,000;

(e) Systems that serve envelope dominated spaces whose design space sensible cooling load, excluding transmission and infiltration loads, is less than or equal to transmission and infiltration losses at an outdoor temperature of 60 °F;

(f) Systems serving residential spaces including hotel/motel rooms;

(g) Cooling systems for which 75% of its annual energy consumption is provided by site-recovered energy that would otherwise be wasted, or from non-depletable energy sources; and

(h) The zone(s) served by the system each have operable openings (windows, doors, etc.), the openable area of which is greater than 5% of the conditioned floor area. This exception applies only to spaces open to and within 20 ft of the operable openings. Automatic controls shall be provided that lockout system mechanical cooling when outdoor air temperatures are less than 60 °F.

7.4.2.2 Economizer systems shall be capable of providing partial cooling even when additional mechanical cooling is required to meet the remainder of the cooling load.

7.4.2.2.1 *Exceptions to Section 7.4.2.2.*

(a) Direct expansion systems may include controls to reduce the quantity of outside air as required to prevent coil frosting at the lowest step of compressor unloading. Individual direct expansion units that have a cooling capacity of 180,000 Btu/h or less may use economizer controls that preclude economizer operation whenever mechanical cooling is required simultaneously; and

(b) Systems in climates with less than 750 average hours per year between 8 a.m. and 4 p.m. when the ambient dry bulb temperatures are between 55 °F and 69 °F inclusive. See Attachment 5A for climate data for 234 U.S. cities.

7.4.2.3 System design and economizer controls shall be such that economizer operation does not increase the building heating energy use during normal operation.

7.4.2.3.1 *Exception to section 7.4.2.3:*

(a) At least 75% of the energy for heating is provided from site-recovered energy that would otherwise be wasted, or from non-depletable energy sources.

7.4.3 Fan System Design Requirements.

7.4.3.1 The following design criteria apply to all HVAC fan systems used for comfort heating, ventilating and/or cooling. For the purposes of this subsection, the energy demand of a fan is the sum of the demand of all fans that are required to operate at design conditions to supply air from the heating and/or cooling source to the conditioned space(s) and return it back to the source or exhaust it to the outdoors.

7.4.3.1.1 *Exceptions to section 7.4.3.1:*

(a) Systems with total fan system motor horsepower of 10 hp or less;

(b) Unitary equipment for which the energy used by the fan is considered in the efficiency ratings of Section 8.4; and

(c) Total fan energy demand need not include the additional power required by air treatment or filtering systems with final pressure drops in excess of 1 in. W.C.

7.4.3.2 Constant Volume Fan Systems.

7.4.3.2.1 For supply and return fan systems that provide a constant air volume whenever the fans are operating, the power required for the combined fan system at design conditions shall not exceed 0.8 W/cfm of supply air.

7.4.3.3 *Variable Air Volume (VAV) Fan Systems.*

7.4.3.3.1 For supply and return fan systems that vary system air volume automatically as a function of load, the power required by the motors for the combined system at design conditions shall not exceed 1.25 W/cfm.

7.4.3.3.2 Individual VAV fans with motors 75 hp and larger shall include controls and devices necessary for the fan motor to control demand to no more than 50% of design wattage at 50% of design air volume, based on manufacturer's test data.

7.4.4 *Pumping System Design Criteria.*

7.4.4.1 The following design criteria apply to all HVAC pumping systems used for comfort heating and/or cooling. For the purposes of this section, the energy demand of a pumping system is the sum of the demand of all pumps that are required to operate at design conditions to supply fluid from the heating and/or cooling source to the conditioned space(s) or heat transfer device(s) and return it to the source.

7.4.4.1.1 *Exception to section 7.4.4.1:*

(a) Systems with total pump system motor horsepower of 10 hp or less.

7.4.4.2 *Friction Rate.* Piping systems shall be designed at a design friction pressure loss rate of no more than 4.0 ft of water per 100 equivalent ft of pipe. Lower friction rates may be required for proper noise or corrosion control.

7.4.4.3 *Variable Flow.* Pumping systems that serve control valves designed to modulate or step open and close as a function of load, shall be designed for variable fluid flow. The system shall be capable of reducing flow to 50% of design flow or less. Flow may be varied by one of several methods, including, but not limited to, variable speed driven pumps, staged multiple pumps, or pumps riding their characteristic performance curves.

7.4.4.3.1 *Exceptions to section 7.4.4.3:*

(a) Systems where a minimum flow greater than 50% of the design flow is required for the proper operation of equipment served by the system, such as chillers;

(b) Systems that serve no more than one control valve;

(c) Where the overall building energy use resulting from an alternative design, such as a constant flow/variable temperature pumping system, is no more than those from a variable flow system; and

(d) Systems that include supply temperature reset controls in accordance with section 7.4.5.2 without exception.

7.4.5 *System Temperature Reset Controls.*

7.4.5.1 *Air Systems.* Systems supplying heated or cooled air to multiple zones shall include controls that automatically reset supply air temperatures by representative building loads or by outside air temperature. Temperature shall be reset by at least 25% of the design supply-air-to-room-air temperature difference. Zones that are expected to experience relatively constant loads, such as interior zones, shall be designed for the fully reset supply temperature.

7.4.5.1.1 *Exceptions to section 7.4.5.1:*

(a) Systems which comply with section 7.4.1 without using exceptions in sections 7.4.1.2.1 or 7.4.1.2.2; and

(b) Where it can be shown that supply air temperature reset increases overall building annual energy costs.

7.4.5.2 *Hydronic Systems.* Systems supplying heated and/or chilled water to comfort conditioning systems shall include controls that automatically reset supply water temperatures by representative building loads (including return water temperature) or by outside air temperature. Temperature shall be reset by at least 25% of the design supply-to-return water temperature difference.

7.4.5.2.1 *Exceptions to section 7.4.5.2:*

(a) Systems that comply with section 7.4.4.3 without exception;

(b) Where it can be shown that supply temperature reset increases overall building annual energy use;

(c) Systems for which supply temperature reset controls cannot be implemented without causing improper operation of heating, cooling, humidification, or dehumidification systems; or

(d) Systems with less than 600,000 Btu/h design capacity.

§ 435.108 Heating, ventilation and air-conditioning (HVAC) equipment.

8.1 General

8.1.1 This section contains minimum requirements for fundamental to good practice and/or the minimum acceptable state-of-the-art in energy efficient HVAC equipment.

8.1.2 A building shall be considered in compliance with this section if the minimum requirements of Section 8.3 are met.

8.2 Principles of Design

8.2.1 The rate of energy input(s) and the heating or cooling output(s) of all HVAC products shall be ascertained. This information shall be based on equipment in new condition, and shall cover full load, partial load, and standby conditions. The information shall also include performance data for modes of equipment operation and at ambient conditions as specified in the minimum equipment performance requirements below.

8.2.2 Source Systems

8.2.2.1 To allow for HVAC equipment operation at the highest efficiencies, conversion devices shall be matched to load increments, and operation of modules shall be sequenced. Oversized or large scale systems shall never be used to serve small seasonal loads (e.g., a large heating boiler to serve a summer service water heating load). Specific "low load" units shall be incorporated in the design where prolonged use at minimal capacities is expected.

8.2.2.2 Storage techniques should be used to level or distribute loads that vary on a time or spatial basis to allow operation of a device at maximum (full-load) efficiency.

8.2.2.3 All equipment shall be the most efficient (or highest COP) practical, at both design and reduced capacity (part-load) operating conditions.

8.2.2.4 Fluid temperatures for heating equipment shall be as low as practical and for cooling equipment as high as practical, while meeting loads and minimizing flow quantities.

8.3 Minimum Requirements

8.3.1 Equipment Efficiency

8.3.1.1 *Minimum Equipment Efficiency.* Equipment shall have a minimum efficiency at the specified rating conditions, not less than the values shown in Tables 8.3-1 through 8.3-10. Minimum efficiencies for equipment using chlorofluorocarbons (CFCs) refrigerants reflect the assumption that the use of certain refrigerants may be restricted because of ozone layer depletion concerns.

8.3.1.2 Data furnished by the equipment supplier or certified under a nationally-recognized certification program or rating procedure may be used to satisfy these requirements.

8.3.1.3 Integrated Part-Load Value (IPLV) is the descriptor for part-load efficiency for certain types of equipment. The IPLVs are found in the referenced ARI Standards. Compliance with minimum efficiency requirements specified for certain HVAC equipment shall include compliance with part-load requirements as well as standard or full-load requirements.

8.3.1.4 If nationally-recognized test procedures for combined equipment are not available, efficiencies for service water heating shall be determined using data provided by equipment and component manufacturers, employing reasonable assumptions concerning uncertain parameters.

8.3.1.5 Omission of minimum performance requirements for certain classes of HVAC equipment does not preclude use of such equipment where appropriate.

8.3.2 Field Assembled Equipment and Components

8.3.2.1 Where components, such as indoor or outdoor coils, from more than one manufacturer are used as parts of a cooling or heating unit, it shall be the responsibility of the system designer to specify component efficiencies, which when combined will provide equipment that is in compliance with the requirements of these standards, based on data provided by the component manufacturers.

8.3.2.2 Total on-site energy input to the equipment shall be determined by combining the energy inputs to all components, elements, and accessories including but not limited to compressor(s), internal circulating pump(s), condenser-air fan(s), evaporative-condenser cooling water pump(s), purge devices, viscosity control heaters, and controls.

8.3.2.3 *Heat-Operated Water Chilling Package.* Double-effect, heat-operated water chilling packages shall be used in lieu of single-effect equipment, due to their higher efficiency, except where the energy input is from low temperature waste-heat or non-depletable energy sources.

8.3.3 Equipment Controls

8.3.3.3 Heat pumps equipped with supplementary resistance heaters for comfort heating shall be installed with a control to prevent heater operation when the heating load can be met by the heat pump. A two-stage room thermostat, that controls the supplementary heat on its second stage, will meet this requirement. Supplementary heater operation is permitted where it can be shown that supplementary heating reduces energy use. Supplementary heater operation is permitted during short transient periods of less than 15 minutes during defrost cycles.

8.3.3.3.1 Controls shall provide a means of activating the supplementary heat source on an emergency basis and a visible indicator shall be provided to indicate the emergency heat status.

8.3.3.4 *Cooling Equipment Auxiliary Controls.* Evaporator coil frosting and excessive compressor cycling at part-load conditions shall not be controlled by use of either hot gas by-pass or evaporator pressure regulator control.

8.3.4 Comfort Heating Equipment

8.3.4.1 The designer shall obtain data and information from the manufacturer of electric resistance comfort heating equipment regarding full-load and part-load energy consumption of the heating equipment over the range of voltages at which the equipment is intended to operate. All auxiliaries required for the operation of the heater equipment such as, but not limited to fans, pumps, viscosity control heaters, fuel handling equipment, and blowers shall be included in the energy input data provided by the manufacturer(s).

8.3.5 Maintenance

8.3.5.1 Provisions shall be made to provide necessary preventive maintenance information to maintain efficient operation of all HVAC equipment.

Table 8.3-1
Standard Rating Conditions and Minimum Performance
Unitary Air Conditioners and Heat Pumps - Air-Cooled, Electrically-Operated
<135,000 Btu/h Cooling Capacity - Except Packaged Terminal and Room Air Conditioners

Reference Standards	Category	Phases	Subcategory & Rating Condition (Outdoor Temps. °F)	Minimum Performance
	<65,000 Btu/h		Seasonal Rating[1]	
ARI 210-81	Cooling Capacity	1	Split-System	10.0 SEER
ARI 240-81	Cooling Mode		Single-Package	9.7 SEER
ARI 210/ 240-84	<65,000 Btu/h		Standard Rating (95 db)	
	Cooling Capacity	3	Split-System & Single-Pkg.	9.5 EER
	Cooling Mode		Integrated Part-Load Value (80 db)	
			Split-System & Single-Pkg.	8.5 IPLV
	≥65,000 <135,000 Btu/h		Standard Rating (95 db)	8.9 EER
	Cooling Mode	All	Integrated Part-Load Value (80 db)	8.3 IPLV
	<65,000 Btu/h		Seasonal Rating[1]	
	Cooling Capacity	1	Split-Systems	6.6 HSPF
	Heating Mode (Heat Pumps)		Single-Package	6.6 HSPF
	<65,000 Btu/h		Split-System & Single Pkg.	
	Cooling Capacity	3	High Temp. Rating (47db/43wb)	3.0 COP
	Heating Mode		Low Temp. Rating (17db/15/wb)	2.0 COP
	≥65,000 <135,000 Btu/h		Split-System & Single Pkg.	
	Cooling Capacity	All	High Temp. Rating (47db/45wb)	3.0 COP
	Heating Mode		Low Temp. Rating (17db/15wb)	2.0 COP

[1] To be consistent with National Appliance Energy Conservation Act of 1987 (Pub. L. 100-12)

Table 8.3-2

Standard Rating Conditions and Minimum Performance

itary Air Conditioners and Heat Pumps - Evaporatively-Cooled, Electrically-Operated - Cooling Mode

<135,000 Btu/h Cooling Capacity - Except Packaged Terminal and Room Air Conditioners

Reference Standards	Category	Rating Condition °F		Minimum Performance
		Indoor Temp.	Outdoor Temp.	
ARI 210-81	<65,000 Btu/h Cooling Capacity	Standard Rating 80db/67wb	95db/75wb	9.3 EER
	<65,000 Btu/h	Integrated Part-Load Value (80db/67wb)		8.5 IPLV
ARI 210/270-84	≥65,000 <135,000 Btu/h	Standard Rating 80db/67wb	95db/75wb	10.5 EER
CTI 201 (86)	≥65,000 <135,000 Btu/h	Integrated Part-Load Value (80db/67wb)		9.7 IPLV

Table 8.3-3
Standard Rating Conditions & Minimum Performance
Water-Cooled Air Conditioners and Heat Pumps -Cooling Mode
<135,000 Btu/h Cooling Capacity - Electrically-Operated

Reference Standard	Category	Rating Condition °F Indoor Air	 Entering Water	Minimum Performance
Water-Source	<65,000 Btu/h	Standard Rating		
Heat Pumps	Cooling Capacity	80db/67wb	85	9.3 EER
ARI 320-86		Low Temperature Rating		
CTI 201 (86)		80db/67wb	75	10.2 EER
	>65,000 <135,000 Btu/h	Standard Rating		
	Cooling Capacity	80db/67wb	85	10.5 EER
Groundwater-Cooled		Standard Rating		
Heat Pumps	<135,000 Btu/h	70 F Entering Water		11.0 EER
ARI 325-85	Cooling Capacity	Low Temperature Rating		
		50 F Entering Water		11.5 EER
Water-Cooled		Standard Rating		
Unitary	<65,000 Btu/h	80db/67wb	85	9.3 EER
Air Conditioners	Cooling Capacity	Integrated Part-Load Value		
ARI 210-81		75 F Entering Water		8.3 IPLV
ARI 210/240-84	≥65,000 <135,000 Btu/h	Standard Rating		
CTI 201 (86)	Cooling Capacity	80db/67wb	85	10.5 EER

Table 8.3-4a
Standard Rating Conditions and Minimum Performance
Packaged Terminal Air Conditioners and Heat Pumps
Air-Cooled, Electrically-Operated

Reference Standards	Category	Subcategory & Rating Condition (Outdoor Temps. °F)	Minimum Performance
ARI 310-87	PTAC's & PTAC H.P.'s[2] Cooling Mode	Standard Rating (95 db)	10.0-(.16 x Cap. (Btu/h)/1000) EER
		Low Temp. Rating (82 db)[1]	12.2-(.20 x Cap. (Btu/h)/1000) EER
ARI 380-87	PTAC H.P.'s - Heating Mode	Standard Rating (47db/43wb)	2.7 COP

1. For multi-capacity equipment the minimum performance shall apply to each capacity step provided and allowed by the controls.
2. If the unit's capacity is less than 7000 Btu/h, use 7000 Btu/h in the calculation. If the unit's capacity is greater than 15000 Btu/h, use 15000 Btu/h in the calculation.

Table 8.3-4b

Standard Rating Conditions & Minimum Performance

Room Air Conditioners and Room Air Conditioner Heat Pumps

Reference ANSI/AHAM RAC-1-82	Category	Minimum Performance[1]
	Without Reverse Cycle and With Louvered Sides	
	< 6000 Btu/h	8.0 EER
	≥ 6000 < 8000 Btu/h	8.5 EER
	≥ 8000 < 14000 Btu/h	9.0 EER
	≥ 14000 < 20000 Btu/h	8.8 EER
	≥ 20000 Btu/h	8.2 EER
	Without Reverse Cycle and Without Louvered Sides	
	< 6000 Btu/h	8.0 EER
	≥ 6000 < 20000 Btu/h	8.5 EER
	≥ 20000 Btu/h	8.0 EER
	With Reverse Cycle and With Louvered Sides	8.5 EER
	With Reverse Cycle, Without Louvered Sides	8.0 EER

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1. To be consistent with National Appliance Energy Conservation Act of 1987 (Pub. L. 100-12).

Table 8.3-5

Standard Rating Conditions and Minimum Performance

Water-Source and Groundwater-Source Heat Pumps - Electrically-Operated

<135000 Btu/h Cooling Capacity

Reference Standards	Rating Condition °F[1]	Minimum Performance
Water-Source Heat Pumps ARI 320-86 CTI 201 (86)	Standard Rating 70 F Entering Water[2]	3.8 COP
Groundwater-Source Heat Pumps ARI 325-85	1. High Temperature Rating 70 F Entering Water[2]	3.4 COP
	2. Low Temperature Rating 50 F Entering Water[2]	3.0 COP

1. Air entering indoor section 70db/60wb (max.).
2. Water Flow Rate Per Manufacturer's Specifications.

Table 8.3-6

Standard Rating Conditions and Minimum Performance

Large Unitary Air Conditioners and Heat Pumps - Electrically-Operated

≥ 135,000 BTU/H Cooling Capacity

Category/ Reference Standards	Efficiency Rating	Minimum Performance	
Air Conditioners	EER	≤ 760,000 Btu/h	> 760,000 Btu/h
Air-Cooled ARI 360-65	IPLV	7.5	
Air Conditioners	EER	9.6	
Water/Evap.-Cooled ARI 360-85, CTI 201 (86)	IPLV	9.0	
Heat Pumps -Air-Cooled - Cooling	EER	≤ 760,000 Btu/h	> 760,000 Btu/h
	IPLV	7.5	
-Air-Cooled - Heating	COP (47 °F)	2.9	
ARI 340-86	COP (17 °F)	2.0	
Condensing Units	EER	9.9	
Air Cooled ARI 365-87	IPLV	11.0	
Condensing Units	EER	12.9	
Water/Evap.-Cooled ARI 365-87, CTI 201 (86)	IPLV	12.9	

1. For units that have a heating section, deduct 0.2 from all required EER's and IPLV's.
2. Condensing unit requirements are based on single-number ratings defined in paragraph 5.1.3.2 of ARI Standard 365-87.

Table 8.3-7

Standard Rating Conditions and Minimum Performance

Water-Chilling Packages - Water- and Air-Cooled - Electrically-Operated

Reference Standards	Category	Efficiency Rating	Minimum Performance
ARI 550-86 & ARI 590-86 CTI 201 (86)	Water - Cooled		
	≥ 300 tons	COP	5.2[1]
		IPLV	5.3[1]
	≥ 150 Tons < 300 tons	COP	4.2
		IPLV	4.5
	< 150 tons	COP	3.8
		IPLV	3.9
	Air-Cooled With Condenser		
	≥ 150 tons	COP	2.5
		IPLV	2.5
	< 150 tons	COP	2.7
		IPLV	2.8
	Condenserless, Air-Cooled		
	All Capacities	COP	3.1
		IPLV	3.2

[1] Where R-22 or CFC refrigerants with equivalent ozone depletion factors are used these requirements are reduced to 4.7 COP and 4.8 IPLV (see Section 8.3.1.1)

NOTE: The levels above are minimum performance levels. Better energy efficiencies may be available, and their use is encouraged.

Table 8.3-8

Standard Rating Conditions and Minimum Performance

Boilers: Gas- and Oil-Fired

Reference	Category	Rating Condition	Minimum Performance
DOE Test Procedure 10 CFR, Part, 30 App N	Gas-Fired <300,000 Btu/h	Seasonal Rating	AFUE 80%^{1,3}
	Oil-Fired <300,000 Btu/h	Seasonal Rating	AFUE 80%^{1}
AGA Z21.13-82 H.I. Htg. Boiler Std. 86 ASME PTC4.1-64 U.L. 795-73	Gas-Fired ≤300,000 Btu/h	1. Max. Rated Cap.^{2} Steady-State	E_c^{4} 80%
		2. Min. Rated Cap.^{2} Steady-State	E_c^{4} 80%
U.L. 726-75 H.I. Htg. Boiler Std. 86 ASME PTC 4.1-64	Oil-Fired ≥300,000 Btu/h	1. Max. Rated Cap.^{2} Steady-State	E_c^{4} 83%
		2. Min. Rated Cap.^{2} Steady-State	E_c^{4} 83%
H.I. Htg. Boiler Std. 86 ASME PTC 4.1-64	Oil-Fired (Residual) ≥300,000 Btu/h	1. Max. Rated Cap.^{2} Steady-State	E_c^{4} 83%
		2. Min. Rated Cap.^{2} Steady-State	E_c^{4} 83%

1. To be consistent with National Appliance Energy Conservation Act of 1987 (Pub. L. 100-12).
2. Provided and allowed by the controls.
3. Except for gas-fired steam boilers for which minimum AFUE is 75%.
4. E_c = combustion efficiency, 100% - flue losses.

Table 8.3-9
Standard Rating Conditions and Minimum Performance
Warm-Air Furnaces and Combination Warm-Air Furnaces/Air-Conditioning Units

Reference	Category	Rating Condition	Minimum Performance
DOE Test Procedure 10 CFR, Part 30 App. N	Gas-Fired <225,000 Btu/h	Seasonal Rating	AFUE 78% [1,3]
	Oil-Fired <225,000 Btu/h	Seasonal Rating	AFUE 78% [1]
AGA Z21.47-83	Gas-Fired ≥225,000 Btu/h	1. Max. Rated Cap.[2] Steady-State	E_t[4] 80%
		2. Min. Rated Cap.[2] Steady-State	E_t[4] 78%
U.L. 727-86	Oil-Fired ≥225,000 Btu/h	1. Max. Rated Cap.[2] Steady-State	E_t[4] 81%
		2. Min. Rated Cap.[2] Steady-State	E_t[4] 81%

1. To be consistent with National Appliance Energy Conservation Act of 1987 (Pub. L. 100-12).
2. Provided and allowed by the controls.
3. Minimum performance requirements for furnaces <45,000 Btu/h capacity are to be established by DOE under Pub. L. 100-12.
4. E_t = thermal efficiency, 100% - flue losses.

Table 8.3-10

Warm Air Duct Furnaces and Unit Heaters

Reference	Category	Rating Conditions	Minimum Performance
AGA Z83.9-86	Duct Furnaces	1. Max. Rated Cap.[1]	E_t[2]
	Gas-Fired	Steady-State	78%
		2. Min. Rated Cap.[1]	E_t[2]
		Steady-State	75%
AGA Z83.8-85	Unit Heaters	1. Max. Rated Cap.[1]	E_t[2]
	Gas-Fired	Steady-State	78%
		2. Min. Rated Cap.[1]	E_t[2]
		Steady-State	75%
U.L 731-75	Unit Heaters	1. Max. Rated Cap.[1]	E_t[2]
	Oil-Fired	Steady-State	81%
		2. Min. Rated Cap.[1]	E_t[2]
		Steady-State	78%

1. Provided and allowed by the controls.
2. E_t = thermal efficiency, 100% -flue losses.

§ 435.109 Service water heating systems.

9.1 General

9.1.1 This section contains minimum and prescriptive requirements for the design of Service Water Heating Systems.

9.1.2 A building shall be considered in compliance with this section if the following conditions are met:

9.1.2.1 The minimum requirements of section 9.3 are met; and

9.1.2.2 The Service Water Heating System design complies with the prescriptive criteria of section 9.4.

9.2 Principles of Design

9.2.1 Showerheads shall be designed to provide and maintain user comfort and energy savings. They should not use removable flow restricting inserts to meet flow limitation requirements.

9.2.2 Point of use water heaters shall be considered where their use will reduce energy consumption and is life cycle cost effective.

9.2.3 High temperature condensate, when returned to condensation pump tanks or other vented tanks, will have a certain portion flashed into steam, thus wasting energy. To conserve this energy, a heat exchanger shall be considered for use in the condensate return line to heat or preheat the service water, cool the condensate, and prevent flashing.

9.2.4 Storage may be used to optimize heat recovery when the flow of heat to be recovered is out of phase with the demand for heated water, or when energy use for water heating can be shifted to take advantage of off-peak rates.

9.3 Minimum Requirements

9.3.1 Sizing of Systems

9.3.1.1 Service water heating system design loads for the purpose of sizing and selecting systems shall be determined in accordance with the procedures described in chapter 54 of the ***ASHRAE Handbook, 1987 HVAC Systems and Applications Volume***, or a similar computation procedure.

9.3.2 Equipment Efficiency

9.3.2.1 All water heaters and hot water storage tanks shall meet the criteria of Table 9.3-1. Where multiple criteria are listed, all criteria shall be met. Where no criteria are provided, no requirements need be met.

Table 9.3-1 (January 30, 1989)
Standard Rating Conditions & Minimum Performance of Water Heating Equipment

Type	Fuel	Storage Capacity (Gal)	Input Rating	Applicable Test Procedure	Minimum Performance		
					DOE Rating	Eff.	Loss
Storage Water Heaters	Electric	≤120	≤12 kW	DOE Test Procedures, 1985 Code of Federal Regulations Title 10, Part 430	EF ≥0.95-0.00132V	- -	- -
		>120 (or)	>12kW	ANSI C72.1 - 1972	- -	- -	SL <1.9 W/ft^2
	Gas	≤100	≤75,000 Btu/h	DOE Test Procedures, 1985 Code of Federal Regulations Title 10, Part 430	EF ≥0.62-0.0019V	- -	- -
		>100 (or)	>75,000 Btu/h	ANSI Z21.10.3-1984 Gas Water Heaters w/Addenda Z21.10.3a-1985	- -	E_t 77%	SL <1.3+ 38/V
	Oil	≤50	≤75,000 Btu/h	DOE Test Procedures, 1985 Code of Federal Regulations Title 10, Part 430	EF ≥0.59-0.0019V	- -	- -
			≤105,000 Btu/h		>0.59-0.0019V	-	-
		>50 (or)	>105,000 Btu/h		- -	E_c 83%	SL <1.3+ 38/V

Table 9.3-1 (January 30, 1989)

Standard Rating Conditions & Minimum Performance of Water Heating Equipment (Cont.)

	Type			Applicable Test Procedure	Minimum Performance	
Class	Fuel	Capacity	Input Rating			
Unfired Storage	1	All Volume	All Inputs		-	HL
					-	<6.5 Btu/h·ft^2
Instantaneous	Gas	-	All Inputs	ANSI Z21.10.3-1984	E_t	-
					80%	-
	Distill Oil	-	All Inputs		E_c	-
					83%	-
Pool Heaters	Gas/ Oil	-	All Inputs	ANSI Z21.56-1986	E_t	-
					78%^{c}	-

Notes for Table 9.3-1:

Terms Defined:

1. EF = Energy factor, overall heater efficiency by DOE Test Procedure
   E_t = Thermal efficiency with 70°F, ΔT
   E_c = Combustion efficiency, 100 percent - flue loss when smoke = 0 (trace is permitted)
   SL = Standby loss in W/ft^2 based on 80°F, ΔT, or in percent per hour based on nominal 90°F, ΔT
   HL = Heat loss of tank surface area
   V = Storage volume in gallons

9.3.2.1.1 *Exception to section 9.3.2.1* (a) storage water heaters and hot water storage tanks having more than 500 gallons of storage capacity need not meet the standby loss (SL) or heat loss (HL) requirements of Table 9.3-1 if the tank surface area is thermally insulated to R-12.5 and if a standing pilot light is not used.

9.3.2.2 *Heat Traps.* Storage water heaters not equipped with integral heat traps and having vertical pipe risers shall be installed with heat traps on both the inlet and outlets. The heat trap shall be installed directly, or as close as possible to the outlet fittings. Circulating systems need not employ heat traps.

9.3.2.2.1 A heat trap may take the form of a bent piece of tubing that forms a loop of 360 degrees; an arrangement of pipe fittings, such as elbows, connected so that the inlet and outlet piping make vertically upward runs just before turning downward to connect to the water heater's inlet and outlet fittings; a commercially available heat trap; or any other type that effectively restricts the natural tendency of hot water to rise in the vertical pipe during standby periods.

9.3.2.2.2 When the water heater outlet is directly horizontal out of the tank, or is piped with an elbow on the vertical outlet and then downward, this piping arrangement itself is effectively a heat trap and a separate heat trap is not then needed.

9.3.3 Piping Insulation

9.3.3.1 For circulating systems, piping insulation shall conform to the requirements of Table 7.3-1 or an equivalent level as calculated in accordance with Equation 7.3-1.

9.3.3.2 For non-circulating systems, the first 8 ft of piping from a storage system that is maintained at a constant temperature shall be insulated in accordance with Table 7.3-1, or an equivalent level as calculated in accordance with Equation 7.3-1. Systems without a heat trap to prevent circulation due to natural convection shall be considered circulating systems.

9.3.4 Controls

9.3.4.1 *Temperature.* Service water heating systems shall be equipped with temperature controls capable of adjustment from 90 °F to a temperature setting compatible with intended use, except for systems serving residential dwelling units may be equipped with controls capable of adjustment down to 110 °F only. (See *ASHRAE Handbook, 1987 Systems and Applications Volume,* Chapter 54, Table 3).

9.3.4.1.1 Where temperatures higher than 120 °F are required at certain outlets for a particular intended use, separate remote heaters or booster heaters shall be installed for those outlets unless it can be shown by calculation that either energy is not saved by the application of this requirement or that the total cost over the life of the equipment is not reduced.

9.3.4.1.2 *Circulating Hot Water Systems and Heated Pipes.* Systems designed to maintain temperatures in hot water pipes, including circulating hot water systems and heat tape on water pipes, shall be equipped with automatic controls that can be set to turn off the system when hot water is not required.

9.3.5 Equipment and Control Requirements for the Conservation of Hot Water

9.3.5.1 Showers used for other than safety reasons shall limit the maximum hot water discharge to 2.75 gpm when tested according to *ANSI A112.18.1M-1979,* "Finished and Rough Brass Plumbing Fixtures". The designer shall evaluate the use of lower flow showerheads than 2.75 gpm, particularly for heavily used facilities. Removable flow restricting inserts shall not be used in showerheads to meet this criterion. When flow restricting inserts are used as a component part of a showerhead, they shall be mechanically retained at the point of manufacture. [Mechanically retained means a pushing or pulling force to remove the flow restricting insert at 8 pounds or more.] This requirement shall not apply to showerheads that will cause water to leak nificantly from areas other than the gray face, if the flow restricting insert were removed.

9.3.5.2 Lavatories in public restrooms, with the exception of lavatories for physically handicapped persons, shall be equipped with devices that:

9.3.5.2.1 Limit the flow of hot water to either:

(a) A maximum of 0.5 gpm;

(b) 0.75 gpm if a device or fitting is used that limits the period of water discharge, such as a foot switch, fixture occupancy sensor; or

(c) 2.5 gpm if equitped with a self-closing valve;

9.3.5.2.2 Either be equipped with a foot switch or occupancy sensor or similar device or limit delivery with a self-closing valve or a foot switch to a maximum of 0.25 gallons of hot water for circulating systems;

9.3.5.2.3 Limits delivery with a self-closing valve or a foot switch to a maximum of 0.50 gallons for non-circulating systems; and

9.3.5.2.4 Limits the outlet temperature to a maximum 110 °F.

9.3.6 Swimming Pools

9.3.6.1 *Pool Heaters.* All pool heaters shall meet the criteria of Table 9.3-1 and be equipped with a readily accessible "on-off" switch to allow system shut-off without adjusting the thermostat setting and, when applicable, allow restarting without manually relighting the pilot light.

9.3.6.2 *Pool Covers.* Outdoor heated swimming pools shall be equipped with a pool cover. However, pools deriving over 70% of the energy for heating from non-depletable sources or from recovery of energy that would otherwise be wasted (computed over an operating season) need not be equipped with pool covers.

9.3.6.3 *Time Switches.* Time switches shall be installed on all swimming pool pumps and all electric swimming pool heaters. These switches shall allow for the shutdown of heaters during hours of peak utility demand except as is necessary in peak period operation to maintain water in a clear and sanitary condition in keeping with applicable public health standards.

9.3.6.3.1 *Exceptions to section 9.3.5.3:*

(a) Where public health standards require 24 hour operation of pumps; and

(b) Pumps are required to operate solar pool heating systems.

9.4 Service Hot Water Heating Systems—Prescriptive Compliance Alternative

9.4.1 Combination Service Water Heating/Space Heating Equipment

9.4.1.1 Water heaters used for combination service water and space heating shall meet the appropriate minimum efficiency requirements of both section 8.3 and 9.3.

9.4.1.2 Combination space heating and service water heating equipment shall only be used when at least one of the following conditions is met:

9.4.1.2.1 where the annual space heating energy use is less than 50% of the annual service water heating energy use;

9.4.1.2.2 where the energy input or storage volume of the combined boiler or water heater is less than twice the size of the smaller of the separate boilers or water heaters otherwise required;

9.4.1.2.3 where calculations show that the combined system uses no more energy than separate systems that meet the requirements of sections 8.3 and 9.3; or

9.4.1.2.4 where the input to the combined boiler is less than 150,000 Btu/h.

9.4.1.3 Combination function equipment (space heating, service water heating, cooling, etc.) shall comply with minimum efficiency requirements in accordance with nationally recognized test procedures. Where such procedures are not available for particular equipment designs, compliance shall be determined based on the function representing the maximum annual energy consumption, using data provided by equipment and component manufacturers.

9.4.2 Additional Equipment Efficiency Measures

9.4.2.1 *Electric Water Heaters.* In applications where water temperatures not greater than 145 °F are required, an economic evaluation shall be made on the potential benefit of using an electric heat pump water heater(s) instead of electric resistance water heater(s). The analysis shall compare the extra costs of the heat pump unit with the benefits in reduced energy costs, less increased maintenance costs, over the estimated service life of the heat pump water heater.

9.4.2.1.1 *Exception to section 9.4.2.1:*

(a) Electric resistance water heaters used in conjunction with site-recovered or non-depletable energy sources or off-peak heating with thermal storage.

9.4.2.2 *Gas-Fired Water Heaters.* All gas-fired storage water heaters that use indoor air for combustion or draft hood dilution and that are installed in a conditioned room shall be equipped with a vent damper unless the water heater is already so equipped. Unless the water heater has an available electrical supply, the installation of such a vent damper shall not require an electrical connection. The vent damper shall be listed as meeting appropriate ANSI standards and shall be installed in accordance with manufacturer's instructions and local codes.

9.4.2.2.1 *Exception to section 9.4.2.2:*

(a) where the cost of the damper exceeds the value of reduced energy costs over the damper's lifetime.

9.4.3 Use of Waste Heat, Solar Energy, and Thermal Storage

9.4.3.1 An evaluation shall be made of the potential for the use of condenser heat, waste energy, solar energy, or off-peak heating with thermal storage to reduce water heating energy cost.

9.4.3.2 Storage shall be used to optimize heat recovery when the flow of heat to be recovered is out of phase with the demand for heated water, or when energy use for water heating can be shifted to take advantage of off-peak rates.

[54 FR 4554, Jan. 30, 1989, as amended at 55 FR 23869, June 12, 1990]

§ 435.110 Energy management.

10.1 General

10.1.1 This section contains minimum requirements for building energy management systems. It describes the energy measurement, control, testing and documentation that shall be provided to the building owner. The intent is to minimize energy use by providing the building operator with design, construction and equipment data, along with a means of testing the completed facility.

10.1.2 A building shall be considered in compliance with this section if the minimum requirements of Section 10.3 are met.

10.2 Principles of Design

10.2.1 Energy Management Control Systems

10.2.1.1 An energy management control system is critical to the effective management of building energy. Energy management systems require measurements at key points in the building system and must be capable of part-load operation recognition and be equipped with controls to match system capacity to load demands.

10.2.1.2 Controls cannot correct inadequate source equipment, poorly selected components, or mismatched systems. Energy efficiency requires a design that is optimized by realistic loads prediction, careful system selection, and full control provisions.

10.2.2 Building Operating Documentation

10.2.2.1 The building construction drawings and specifications must show system types, sizes, performance criteria, controls, and materials intended for use prior to construction. The system designer shall provide or specify that documentation be provided for the education and guidance of the building operator showing the actual elements that have been installed, how they have been installed, how they performed during testing, and how they operate as a system in the completed facility. Since minimum energy use is the ultimate goal, operating procedures are one of the major factors in controlling energy use in buildings. The activities of building occupants and operators can result in differences as great as two to one in the energy consumption of essentially similar buildings. While neither the designer nor these standards can control the way the building is actually operated, the designer shall contribute to the education and guidance of the building operator by including this documentation in the contract specifications.

10.2.2.2 The building operator shall be provided with the following:

10.2.2.2.1 As-built drawings and specifications;

10.2.2.2.2 Operating manuals with a schematic diagram, sequence of operation and system operating criteria for each and all systems installed;

10.2.2.2.3 Where the building systems are complex, a comprehensive balancing and testing program and report to demonstrate the energy performance capabilities of the system; and

10.2.2.2.4 Maintenance manuals with complete information for all major components in the facility.

10.3 Minimum Requirements

10.3.1 Each distinct utility-provided energy service shall be metered. This shall apply to central and individual tenant meters. Such meters shall be located, or arranged, so that the meter can be visually monitored.

10.3.2 Each distinct commercially-provided energy service shall have a system to measure and record the amount of energy being delivered, based on the energy content.

10.3.3 The energy delivery systems shall be arranged to allow individual measurement of occupant lighting and outlet services, production processes, auxiliary systems, service water heating, space heating, space cooling, and HVAC delivery systems.

10.3.4 Provisions shall be made for the measurement of energy inputs and outputs (flow, temperature, pressure, etc.) to determine equipment energy consumption and/or installed performance capabilities and efficiencies of all heating, cooling, and HVAC delivery systems equipment, greater than 20 kVA or 60,000 Btu/h energy input.

10.3.5 Energy Measurement Instrumentation

10.3.5.1 In buildings or tenant areas with electric service greater than 150 kVA or fuel use greater than 500,000 Btu/h, energy use shall be measured for electrical lighting, miscellaneous power outlets, HVAC systems and equipment, service hot water, and process loads and when the peak use of:

10.3.5.1.1 Production processes, including manufacturing, computers, laundries, kitchens, etc., is greater than 100 kVA or 300,000 Btu/h;

10.3.5.1.2 Auxiliary systems and service water heating is greater than 100 kVA or 300,000 Btu/h;

10.3.5.1.3 Space heating (including reheat) is greater than 100 kVA or 300,000 Btu/h;

10.3.5.1.4 Space cooling is greater than 100 kVA or 300,000 Btu/h; and

10.3.5.1.5 HVAC delivery systems is greater than 100 kVA or 300,000 Btu/h.

10.3.5.1.6 *Exception to section 10.3.5.1:*

(a) When there is an energy service for only 2 of the 6 categories listed, a single measurement may be made for the larger of the two energy services and the second use determined by subtraction from the primary service measurements.

10.3.6 HVAC System Controls

10.3.6.1 The designer shall designate, specify, or otherwise show in the construction documents the type of controls and control systems needed. This shall include a description or sequence of control of the system's operational procedures.

10.3.6.2 Controls may be electric, pneumatic, electronic, or direct digital. Control action may be "on/off", or proportional that can use manual, automatic, or remote reset and can have rate of action or derivative action compensation as designated by the designer. Control devices may be provided by the manufacturers of equipment or by the field installers, but all shall be compatible with the design sequence of control. The designer shall designate accuracy and long term requirements for controls.

10.3.6.3 All primary energy conversion equipment such as boilers, heat exchangers, refrigeration units, furnaces and heat pumps shall have a load activated local control loop for each piece of equipment. Controls for multiple equipment shall integrate the individual control units or provide system control for all the units.

10.3.6.4 All energy delivery systems shall have a local control loop for each system.

10.3.6.5 Energy consuming systems or components with a peak use greater than 1 kW or 3,500 Btu/h shall be provided with a means of shut-off when occupancy or weather conditions do not require its operation.

10.3.6.6 The control equipment provided for local control loops except for "on/off" and self-contained sensor devices shall be arranged so that sensing, control action, and control setting variables can be read or tested at the device.

10.3.6.7 Control loops for terminal unit zones with less than 24 hours per day or 7 days per week occupancy shall have separate control points for day and night heating and cooling. The devices shall be capable of local resetting, and have provisions for remote management system selection of the occupied or unoccupied heating or cooling mode of operation.

10.3.7 Central Monitoring and Control Systems

10.3.7.1 A central monitoring and control system shall be provided in any building or submetered tenant space exceeding 40,000 ft^2 in gross floor area.

10.3.7.2 The minimum energy management requirements for such a system shall be to:

10.3.7.2.1 Read and retain daily totals for all energy measurement instruments;

10.3.7.2.2 Total all energy values weekly and record and retain values placed on a summary report;

10.3.7.2.3 Record and plot hourly outdoor and indoor temperature against real time and summarise and report for each year in a format compatible with degree-days or bin temperature;

10.3.7.2.4 Based on time schedules, turn on or off any HVAC or service water heating system or equipment;

10.3.7.2.5 Based on time schedules, turn on or off major building lighting and occupancy power circuits;

10.3.7.2.6 Reset local loop control systems for HVAC equipment;

10.3.7.2.7 Monitor and verify operation of heating, cooling and energy delivery systems;

10.3.7.2.8 Monitor and verify operation of lighting and occupant power, auxiliary and service hot water systems;

10.3.7.2.9 Provide readily accessible override controls so that time-based HVAC and lighting controls may be temporarily overridden during off hours; and

10.3.7.2.10 Provide optimum start/stop for HVAC systems.

10.3.8 Completion Requirements

10.3.8.1 The building construction documents shall describe the requirements for placing all energy management systems in operation. This includes check-out procedures and all controls and metering equipment operational information.

10.3.8.2 The building construction documents shall describe the requirements for balancing and check-out procedures for all HVAC systems and equipment. All HVAC system balancing shall be required to be accomplished in a manner to minimize throttling losses. In air systems, fan speeds shall be required to be adjusted to meet design conditions. Water systems shall be required to be proportionally adjusted to minimize throttling losses and then corrected to design flow conditions by trimming the pump impeller or changing pump speed. The design specifications shall state that a pump shall not be brought to final flow conditions by valving.

10.3.8.3 The building construction documents shall describe the requirements for control system testing to sure that control elements are calibrated, ranges adjusted, set points ascertained, and full travel of moveable elements assured. All elements in the control system shall be tested with the system in operation.

10.3.9 Energy Performance Testing

10.3.9.1 The building construction documents shall describe the requirements for determining building energy performance in the completed, operational building.

10.3.9.2 The building energy performance testing shall be performed in winter for heating and in summer for cooling. These tests shall ascertain the in-site capabilities of all HVAC systems and equipment. Internal building loads shall be accounted for in assessing cooling performance. Heating performance shall be determined during unoccupied night time periods during winter weather. If any internal load, such as lighting, contributes to building heating, such loads shall be accounted for in assessing heating performance.

10.3.9.3 Energy use measurements shall be made for the overall building system while HVAC system performance is being tested. Each energy management and control system shall be used to determine energy use for:

10.3.9.3.1 Utility energy;

10.3.9.3.2 Commercial service energy;

10.3.9.3.3 Occupant lighting and receptacle power;

10.3.9.3.4 Production process energy;

10.3.9.3.5 Auxiliary systems and service water heating energy;

10.3.9.3.6 Space heating energy;

10.3.9.3.7 Space cooling energy; and

10.3.9.3.8 HVAC delivery system energy.

10.3.9.3.9 Test periods shall be at least six (6) hours in duration. Hourly outdoor and indoor temperatures, solar intensity during a day test, and wind speed during a night test shall be recorded.

10.3.9.4 The building energy performance test data shall, at minimum, measure energy use and outdoor temperatures hourly for each test period.

10.3.10 Documentation Data Requirements

10.3.10.1 As-built information shall be provided for all the following energy-related features of the building:

10.3.10.1.1 Thermal and solar/optical transmission characteristics of the building envelope, including infiltration;

10.3.10.1.2 The operating characteristics of the HVAC, lighting, and service water heating equipment and systems;

10.3.10.1.3 Internal heat gain contributed by equipment and processes; and

10.3.10.1.4 The operating characteristics of controls.

10.3.10.2 A summary report shall be provided outlining the design basis data for the building envelope, the internal heat gains, the weather extremes, major heating/cooling equipment sizes and sequence of operation.

10.3.10.3 The construction documents shall require that shop drawings, schematic diagrams, control sequence, maintenance manuals, and operating instructions, with data on all HVAC, auxiliary equipment and service water heating systems be provided to the owner.

10.3.10.4 A system balancing report shall be provided that follows National Environmental Balancing Bureau or the Association of Air Balancing Council formats with an extra section summarizing the energy-related values gathered during balancing.

10.3.10.5 An energy performance test report shall be provided showing all the data gathered during the energy performance tests. The results shall be presented in a format that provides convenient comparison with design values.

§ 435.111 Building energy cost compliance alternative.

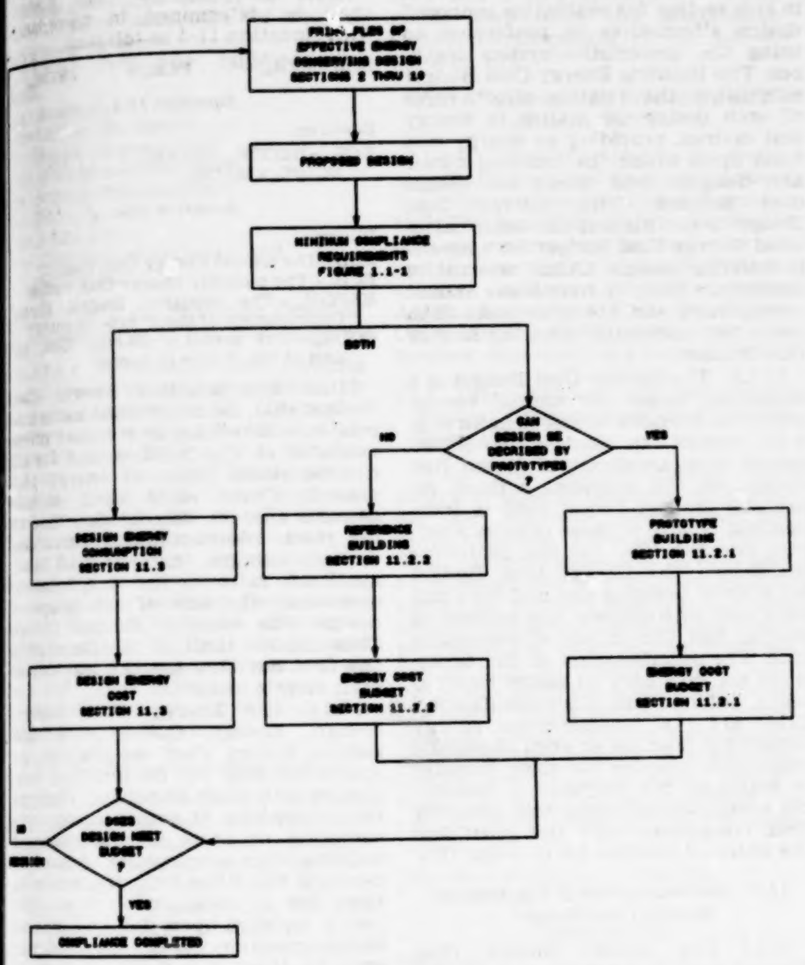
11.1 General

11.1.1 This section provides an alternative compliance path that allows greater flexibility in the design of energy efficient buildings using an annual energy cost method. Energy cost is used as the common denominator in determining compliance. Using unit costs rather than units of energy or power such as Btu, kWh or kW allows the energy use contribution of different fuel sources at different times to be added and compared. This path allows for innovation in designs, materials, and equipment, such as daylighting, passive solar heating, heat recovery, better zonal temperature control, thermal storage, and other applications of off-peak electrical energy, that cannot be adequately evaluated by the prescriptive or system performance alternatives found in sections 3.4, 3.5, 5.4, 5.5, and 7.4. This compliance path is intended for design comparisons only and is not intended to be used to either predict, document, or verify annual energy consumption or annual energy costs.

11.1.2 The Building Energy Cost Compliance Alternative is to be used in lieu of the prescriptive or system performance methods and in conjunction with the minimum requirements found in sections 3.3, 4.3, 5.3, 6.3, 7.3, 8.3, 9.3 and 10.3.

11.1.3 *Compliance.* Compliance under this method requires detailed energy analyses of the entire Proposed Design, referred to as the Design Energy Consumption; an estimate of annual energy cost for the proposed design, referred to as the Design Energy Cost; and comparison against an Energy Cost Budget. Compliance is achieved when the estimated Design Energy Cost is less than or equal to the Energy Cost Budget (see Figure 11-1). This section provides instructions for determining the Energy Cost Budget and for calculating the Design Energy Consumption and Design Energy Cost. The Energy Cost Budget shall be determined through the calculation of monthly energy consumption and energy cost of a Prototype or Reference Building design configured to meet the requirements of sections 3.0 through 10.0.

Figure 11-1 Building Energy Cost Compliance Alternative


PRINCIPLES OF EFFECTIVE ENERGY CONSERVING DESIGN SECTIONS 2 THRU 10
PROPOSED DESIGN
MINIMUM COMPLIANCE REQUIREMENTS FIGURE 1.1-1
BOTH
CAN DESIGN BE DESCRIBED BY PROTOTYPES ?
NO
YES
DESIGN ENERGY CONSUMPTION SECTION 11.3
REFERENCE BUILDING SECTION 11.2.2
PROTOTYPE BUILDING SECTION 11.2.1
DESIGN ENERGY COST SECTION 11.3
ENERGY COST BUDGET SECTION 11.2.2
ENERGY COST BUDGET SECTION 11.2.1
DOES DESIGN MEET BUDGET ?
NO
ESIGN
YES
COMPLIANCE COMPLETED

11.1.4 Designers are encouraged to employ the Building Energy Cost Budget compliance method set forth in this section for evaluating proposed design alternatives in preference to using the prescriptive/system methods. The Building Energy Cost Budget establishes the relative effectiveness of each design alternative in energy cost savings, providing an energy cost basis upon which the building owner and designer may select one design over another. This Energy Cost Budget is the highest allowable calculated Energy Cost Budget for a specific building design. Other alternative designs are likely to have lower annual energy costs and life cycle costs than those that minimally meet the Energy Cost Budget.

11.1.5 The Energy Cost Budget is a numerical target for annual energy cost. It is intended to assure neutrality with respect to choices of HVAC system type, architectural design, fuel choice, etc., by providing a fixed, repeatable budget target that is independent of any of these choices wherever possible (i.e., for the prototype buildings). The Energy Cost Budget for a given building size and type will vary only with climate, the number of stories, and the choice of simulation tool. The specifications of the prototypes are necessary to assure repeatability, but have no other significance. They are not recommended energy conserving practice, or even physically reasonable practice for some climates or buildings, but represent a reasonable worst case of energy cost resulting from compliance with the spirit and the letter of sections 3.0 through 10.0.

11.2 Determination of the Annual Energy Cost Budget

11.2.1 The annual Energy Cost Budgets shall be determined in accordance with the Prototype Building Method in section 11.2.5, or the Reference Building Method in section 11.2.5. Both methods calculate an annual Energy Cost by summing the 12 monthly Energy Cost Budgets. Each monthly Energy Cost Budget is the product of the monthly Building Energy Consumption of each type of energy used multiplied by the monthly Energy Cost per unit of energy for each type of energy used.

11.2.2 The Energy Cost Budget shall be determined in accordance with Equation 11-1 as follows:

$$ECB = ECB_{jan} + \ldots ECB_{m} + \ldots + ECB_{dec}$$

Equation 11-1

Based on:

$$ECB_{m} = BECON_{m1} \times ECOS_{m1} + \ldots + BECON_{mi} \times ECOS_{mi}$$

Equation 11-2

Where:

ECB = The annual Energy Cost Budget
ECB_{m} = The monthly Energy Cost Budget
$BECON_{mi}$ = The monthly Budget Energy Consumption of the i^{th} type of energy
$ECOS_{mi}$ = The monthly Energy Cost, per unit of the i^{th} type of energy

11.2.3 The monthly Energy Cost Budget shall be determined using current rate schedules or contract prices available at the building site for all non-depletable types of energy purchased. These costs shall include demand charges, rate blocks, time of use rates, interruptable service rates, delivery charges, taxes, and all other applicable rates for the type, location, operation, and size of the proposed design. The monthly Budget Energy Consumption shall be calculated from the first day through the last day of each month, inclusive.

11.2.4 The Energy Cost Budget, Design Energy Consumption and Design Energy Cost calculations are applicable only for determining compliance with these standards. They are not predictions of actual energy consumption or costs of the proposed building after construction. Actual experience will differ from these calculations due to variations such as occupancy, building operation and maintenance, weather, energy use not covered by these standards, changes in energy rates between design of the building and occupancy, and precision of the calculation tool.

11.2.5 Prototype Building Procedure

11.2.5.1 The Prototype Building procedure shall be used for all building types listed below. For mixed-use buildings the Energy Cost Budget is derived by allocating the floor space of each building type within the floor space of the prototype building. For buildings not listed below, the Reference Building procedure of section 11.2.5 shall be used.

11.2.5.1.1 Prototype buildings include:

(a) Assembly;
(b) Office (Business);
(c) Retail (Mercantile);
(d) Warehouse (Storage);
(e) School (Educational);
(f) Hotel/Motel;
(g) Restaurant;
(h) Health/Institutional; and
(i) Multi-Family.

11.2.5.2 *Use of the Prototype Building to Determine the Energy Cost Budget*

11.2.5.2.1 Determine the building type of the Proposed Design using the categories in section 11.2.5.1. Using the appropriate Prototype Building characteristics from Tables 11-1 through 11-8, the building shall be simulated using the same gross floor area and number of floors for the Prototype Building as in the Proposed Design.

11.2.5.2.3 The form, orientation, occupancy and use profiles for the Prototype Building shall be fixed as described in section 11.5.3. Envelope, lighting, other internal loads and HVAC systems and equipment shall meet the prescriptive or system requirements of section 3.0 through 10.0 and are standardized inputs.

11.2.6 *Reference Building Method*

11.2.6.1 The Reference Building procedure shall be used only when the Proposed Design cannot be represented by one or a combination of the Prototype Building listed in Section 11.2.5.1 or the assumptions for the Prototype Building in Section 11.5, such as occupancy and use-profiles, do not reasonably represent the Proposed Design.

11.2.6.2 *Use of the Reference Building to Determine the Energy Cost Budget*

11.2.6.2.1 Each floor shall be oriented in the same manner for the Reference Building as in the Proposed Design. The form, gross and conditioned floor areas of each floor and the number of floors shall be the same as in the Proposed Design. All other characteristics, such as lighting, envelope and HVAC systems and equipment, shall meet the prescriptive/system requirements of Section 3.0 through 10.0.

11.2.7 *Calculation Procedure and Simulation Tool*

11.2.7.1 The Prototype or Reference Buildings shall be modeled using the criteria of section 11.5 and section 11.6. The modeling shall use a climate data set appropriate for both the site and the complexity of the energy conserving features of the design. ASHRAE Weather Year for Energy Calculations (WYEC) data or bin weather data shall be a default choice.

11.3 Determination of the Design Energy Consumption and Design Energy Cost

11.3.1 The Design Energy Consumption shall be calculated by modeling the Proposed Design using the same methods, assumptions, climate data, and simulation tool as were used to establish the Energy Cost Budget, except as explicitly stated in 11.5. The Design Energy Cost shall be calculated per Equation 11-3. If the Proposed Design includes cogeneration or nondepletable energy sources designed for the sale of energy off-site, then energy cost and income resulting from outside sales shall not be used to reduce the Design Energy Costs. Such systems shall be modeled as operating to supply energy needs of the Proposed Design only.

$$\mathrm{DECOS} = \mathrm{DECOS}_{jan} + \ldots \mathrm{DECOS}_{m} \quad \ldots\ldots + \mathrm{DECOS}_{dec}$$

Equation 11-3

Based on:

$$\mathrm{DECOS}_{m} = \mathrm{DECON}_{m1} \times \mathrm{ECOS}_{m1} + \quad \ldots + \mathrm{DECON}_{mi} \times \mathrm{ECOS}_{mi}$$

Equation 11-4

Where:

DECOS = The annual Design Energy Cost
DECOS_{m} = The monthly Design Energy Cost
ICON_{mi} = The monthly Design Energy Consumption of the i^{th} type of energy
ECOS_{mi} = The monthly Energy Cost per unit of the i^{th} type of energy

The $DECON_{mi}$ shall be calculated from the first day through the last day of the month, inclusive.

11.4 Compliance

11.4.1 If the Design Energy Cost is less than or equal to the Energy Cost Budget, and all of the minimum requirements of sections 3.0 through 10.0 are met, the Proposed Design complies with the standards.

11.5 Standard Calculation Procedure

11.5.1 The Standard Calculation Procedure consists of methods and assumptions for calculating the Energy Cost Budget for the Prototype or Reference Building and the Design Energy Consumption and Design Energy Cost of the Proposed Design. In order to maintain consistency between the Energy Cost Budget and the Design Energy Cost, the input assumptions to be used are stated below. These inputs shall be used to determine the Energy Cost Budget and the Design Energy Consumption.

11.5.2 Prescribed assumptions shall be used without variation. Default assumptions shall be used unless the designer can demonstrate that a different assumption better characterizes the building's energy use over its expected life. No modified default assumptions shall be used in modeling both the Prototype or Reference Building and the Proposed Design unless the designer demonstrates clear cause to do otherwise. Special procedures for speculative buildings are discussed in section 11.5.9. Shell buildings may not use section 11.0.

11.5.3 Orientation and Shape

11.5.3.1 The Prototype Building shall consist of the same number of stories, and gross and conditioned floor area as the Proposed Design, with equal area per story. The building shape shall be rectangular, with a 2.5:1 aspect ratio. The long dimensions of the building shall face East and West. This is intended to provide an energy budget that can be met even if there are unfavorable site constraints. The fenestration shall be uniformly distributed in proportion to exterior wall area.

11.5.3.2 Floor-to-floor height for the Prototype Building shall be 13 ft except for dwelling units in hotels/motels and multi-family high rise residential buildings where floor-to-floor height shall be 9.5 ft.

11.5.3.3 The Reference Building shall consist of the same number of stories, and gross floor area for each story as the Proposed Design. Each floor shall be oriented in the same manner as the Proposed Design. The geometric form shall be the same as the Proposed Design.

11.5.4 Internal Loads

11.5.4.1 The systems and types of energy specified in this section are intended only as constraints in calculating the Energy Cost Budget. They are not intended as either requirements or recommendations for either systems or the type of energy to be used in the Proposed Design or for calculation of Design Energy Cost.

11.5.4.2 Internal loads for multi-family high rise residential buildings are presented in Table 11-1. These assumptions shall be prescribed assumptions. Internal loads for other building types shall be modeled as noted in this subsection.

11.5.4.2.1 Occupancy

(a) Occupancy schedules shall be Default Assumptions. The same assumptions shall be made in computing Design Energy Consumption as were used in calculating the Energy Cost Budget.

(b) Table 11-2, Occupancy Density, establishes the density, in ft²/person of conditioned floor area, to be used for each building type. Table 11-3, Building Schedule Percentage Multipliers, establishes the percentage of total occupants in the building by hour of the day for each building type.

11.5.4.2.2 Lighting

(a) Interior Lighting Power Allowance (ILPA), for calculating the Energy Cost Budget shall be determined from section 3.0. The lighting power used to calculate the Design Energy Consumption shall be the actual adjusted power for lighting in the Proposed Design. If the lighting controls in the Proposed Design are more effective at saving energy than those required by section 3.3, the actual installed lighting power shall be used along with the schedules reflecting the action of the controls to calculate the Design Energy Consumption. This actual installed lighting power shall not be adjusted by the Power Adjustment Factors listed in Table 3.5-2.

(b) Lighting energy profiles are shown in Table 11-3 that establish the percentage of the lighting load switched-on in each Prototype or Reference Building by hour of the day. These profiles are default assumptions and can be changed when calculating the Energy Cost Budget to provide, for example, a 12 hour rather than an 8 hour work day.

11.5.4.2.3 Receptacles

(a) Receptacle loads and profiles are default assumptions. The same assumptions shall be made in calculating Design Energy Consumption as were used in calculating the Energy Cost Budget.

(b) Receptacle loads include all general service loads that are typical in a building. These loads exclude any process electrical usage and HVAC primary or auxiliary electrical usage. Table 11-4, Receptacle Power Densities, establishes the density, in W/ft^2, to be used for each building type. The receptacle energy profiles shall be the same as the lighting energy profiles in Table 11-3. This profile establishes the percentage of the receptacle load that is switched on by hour of the day and by building type.

11.5.5 Building Exterior Envelope

11.5.5.1 Insulation and Glazing

11.5.5.1.1 The insulation and glazing characteristics of the Prototype and Reference Building envelope shall be determined by using the first column under "Base Case", with no assumed overhangs for the appropriate Alternate Component Tables (ACP) in section 5.0, as defined by climate range. The insulation and glazing characteristics from this ACP are Prescribed Assumptions for Prototype and Reference Buildings for calculating the Energy Cost Budget. In calculating the Design Energy Consumption of the Proposed Design, the envelope characteristics of the Proposed Design shall be used.

11.5.5.2 Infiltration

11.5.5.2.1 For Prototype and Reference Buildings, infiltration assumptions shall be prescribed assumptions for calculating the Energy Cost Budget and default assumptions for the Design Energy Consumption. Infiltration shall impact perimeter zones only.

11.5.5.2.2 When the HVAC system is switched "on", no infiltration shall be assumed. When the HVAC system is switched "off", the infiltration rate for buildings with or without operable windows shall be assumed to be 0.038 cfm/ft^2 of gross exterior wall. Hotels/motels and multi-family high rise residential buildings shall have infiltration rates of 0.038 cfm/ft^2 of gross exterior wall area at all times.

11.5.5.3 Envelope and Ground Absorptivities

11.5.5.3.1 For Prototype and Reference Buildings, absorptivity assumptions shall be prescribed assumptions for computing the Energy Cost Budget and default assumptions for computing the Design Energy Consumption. The solar absorptivity of opaque elements of the building envelope is assumed to be 70%. The solar absorptivity of ground surfaces is assumed to be 80% (20% reflectivity).

11.5.5.4 Window Management

11.5.5.4.1 For the Prototype and Reference Building, window management drapery assumptions shall be prescribed assumptions for setting the Energy Cost Budget. No draperies shall be the default assumption for computing the Design Energy Consumption. Glazing is assumed to be internally shaded by medium-weight draperies, closed one-half time. The draperies shall be modeled by assuming that one-half the area in each zone is draped and one-half is not. If manually-operated draperies, shades, or blinds are to be used in the Proposed Design, the Design Energy Consumption shall be calculated by assuming they are effective over one-half the glazing area in each zone.

11.5.5.5 Shading

11.5.5.5.1 For Prototype and Reference buildings and the Proposed Design, shading by permanent structures, terrain, and vegetation shall be taken into account for computing energy consumption, whether or not these features are located on the building site. A permanent fixture is one that is likely to remain for the life of the Proposed Design.

11.5.6 HVAC Systems and Equipment

11.5.6.1 The specifications and requirements for the HVAC systems of the Prototype and Reference Buildings shall be those in Table 11-5, HVAC Systems for Prototype and Reference Buildings. For the calculation of the Design Energy Consumption, the HVAC systems and equipment of the Proposed Design shall be used.

11.5.6.2 The systems and types of energy presented in Table 11-5 are intended only as constraints in calculating the Energy Cost Budget. They are not intended as either requirements or recommendations for either systems or the type of energy to be used in the Proposed Building or for the calculation of the Design Energy Cost.

11.5.6.3 HVAC Zones

11.5.6.3.1 HVAC zones for calculating the Energy Cost Budget of the Prototype or Reference Building shall consist of at least four perimeter and one interior zones per floor. Prototype Buildings shall have one perimeter zone facing each cardinal direction. The perimeter zones of Prototype and Reference Buildings shall be 15 ft in width, or one-third the narrow dimension of the building, when this dimension is between 30 ft and 45 ft inclusive, or one-half the narrow dimension of the building when this dimension is less than 30 ft. Zoning requirements shall be a default assumption for calculating the Energy Cost Budget. For multi-family high rise residential buildings, the prototype building shall have one zone per dwelling unit. The proposed design shall have one zone per unit unless zonal thermostatic controls are provided within units; in this case, two zones per unit shall be modeled. Building types such as assembly or warehouse may be modeled as a single zone if there is only one space.

11.5.6.3.2 For calculating the Design Energy Consumption, no fewer zones shall be used than were in the Prototype and Reference Buildings. The zones in the simulation shall correspond to the zones provided by the controls in the Proposed Design. Thermally similar zones, such as those facing one orientation on different floors, may be grouped together for the purposes of either the Design Energy Consumption or Energy Cost Budget simulation.

11.5.6.4 Equipment Sizing and Redundant Equipment

11.5.6.4.1 For calculating the Energy Cost Budget of Prototype or Reference Buildings, HVAC equipment shall be sized to meet the requirements of section 7.3.2, without using any of the exceptions. The size of equipment shall be that required for the building without process loads considered. The designer shall determine the final equipment sizing including the process loads by separate calculations. Redundant and/or emergency equipment need not be simulated if it is controlled so that it will not be operated during normal operation of the building. The designer shall document the installation of process equipment and the size of process loads.

11.5.6.4.2 For calculating the Design Energy Consumption, actual air flow rates and installed equipment size shall be used in the simulation, except that excess capacity provided to meet process loads need not be modeled if the process load was not modeled in setting Energy Cost Budget. Equipment sizing in the simulation of the Proposed Design shall correspond to the equipment actually selected for the design and the designer shall not use equipment sized automatically by the simulation tool.

11.5.6.4.3 Redundant and/or emergency equipment need not be simulated if it is controlled to not be operated during normal operations of the building.

11.5.7 Service Water Heating

11.5.7.1 The service water loads for Prototype and Reference Buildings are defined in terms of Btu/h per person in Table 11-6. The service water heating loads from Table 11-6 are prescribed assumptions for multi-family high rise residential buildings and default assumptions for all other buildings. The same service water heating load assumptions shall be made in calculating Design Energy Consumption as were used in calculating the Energy Cost Budget.

11.5.7.2 The service water heating system, including piping losses for the Prototype Building, shall be modeled using the methods of the *ASHRAE Handbook, 1987 HVAC Systems and Applications Volume* using a system that meets all requirements of section 9.0. The service water heating equipment for the Prototype or Reference Building shall be either natural gas or #2 fuel oil, if natural gas is not available at the site, or an electric heat pump.

11.5.7.3 *Exception to section 11.5.7:*

11.5.7.3.1 If electric resistance service water heating is preferable to an electric heat pump when analyzed according to the criteria of section 9.3.7.1 or when service water temperatures exceeding 145 °F are required for a particular application, electric resistance water heating may be used.

11.5.8 Controls

11.5.8.1 All occupied conditioned spaces in the Prototype, Reference and Proposed Design Buildings in all climates shall be simulated as being both heated and cooled. The assumptions in this subsection are prescribed assumptions. If the Proposed Design does not include equipment for cooling or heating, the Design Energy Consumption shall be determined by the specifications for calculating the Energy Cost Budget as described in Table 11-7.

11.5.8.2 *Exceptions to section 11.5.8:*

11.5.8.2.1 If a building is to be provided with only heating or cooling, both the Prototype or Reference Building and the Proposed Design shall be simulated, using the same assumptions. If such an assumption is made, the analysis shall show that the building interior temperature meets the comfort criteria of ***ANSI/ASHRAE 55-1981*** "Thermal Environmental Conditions for Human Occupancy," at least 98% of the occupied hours during the year.

11.5.8.2.2 If warehouses are not intended to be mechanically cooled, both the Energy Cost Budget and Design Energy Consumption shall be modeled assuming no mechanical cooling; and

11.5.8.2.3 In climates where winter design temperature (97.5% occurrence) is greater than 59 °F, space heating need not be modeled.

11.5.8.3 Space temperature controls for the Prototype or Reference Building, except multi-family high rise residential buildings shall be set at 70 °F for space heating and 75 °F for space cooling with a deadband per section 7.3.4.5. The system shut off during off-hours shall be according to the schedule in Table 11-3, except that the heating system shall cycle on if any space should drop below the night setback setting of 55 °F. There shall be no similar setpoint during the cooling season. Lesser deadband ranges may be used in calculating the Design Energy Consumption.

11.5.8.3.1 *Exceptions to section 11.5.8.3:*

(a) Setback shall not be modeled in determining either the Energy Cost Budget or Design Energy Cost if setback is not realistic for tne Proposed Design, such as 24 hour/day operations. Health facilities need not have night setback during the heating season;

(b) Hotel/motels and multi-family high rise residential buildings shall have a night setback temperature of 60 °F from 11:00 p.m. to 6:00 a.m. during the heating season; and

(c) If deadband controls are not to be installed, the Design Energy Cost shall be calculated with both heating and cooling thermostat setpoints set to the same value between 70 °F and 75 °F inclusive, assumed to be constant for the year.

11.5.8.3.2 For multi-family buildings, the thermostat schedule for the dwelling units shall be as in Table 11-8.

(a) The Prototype Building shall use the single zone schedule. The Proposed Design shall use the two-zone schedule only if zonal thermostatic controls are provided. For Proposed Designs that use heat pumps employing supplementary heat, the controls used to switch on the auxiliary heat source during morning warm-up periods shall be simulated accurately. The thermostat assumptions for multifamily high-rise buildings are prescribed assumptions.

11.5.8.4 When providing for outdoor air ventilation in calculating the Energy Cost Budget, controls shall be assumed to close the outside air intake to reduce the flow of outside air to 0 cfm during setback and unoccupied periods. Ventilation using inside air may still be required to maintain scheduled setback temperature. Outside air ventilation, during occupied periods, shall be as required by *ASHRAE Standard 62-1981*, "Ventilation for Acceptable Indoor Air," or the Proposed Design, whichever is greater.

11.5.8.5 If humidification is to be used in the Proposed Design, the same level of humidification and system type shall be used in the Prototype or Reference Building. If dehumidification requires subcooling of supply air, then reheat for the Prototype or Reference Building shall be from recovered waste heat such as condenser waste heat.

11.5.9 Speculative Buildings

11.5.9.1 Lighting

11.5.9.1.1 The interior lighting power allowance (ILPA) for calculating the Energy Cost Budget shall be determined from Table 3.4-1. The Design Energy Consumption may be based on an assumed adjusted lighting power for future lighting improvements.

(a) The assumption about future lighting power used to calculate the Design Energy Consumption must be documented so that the future installed lighting systems may be in compliance with these standards. Documentation must be provided to enable future lighting systems to use either the Prescriptive method of section 3.4 or the Systems Performance method of section 3.5.

(b) Documentation for future lighting systems that use the Prescriptive method of section 3.4 shall be stated as a maximum adjusted lighting power for the tenant spaces. The adjusted lighting power allowance for tenant spaces shall account for the lighting power provided for the common areas of the building.

(c) Documentation for future lighting systems that use the System Performance method of section 3.5 shall be stated as a required lighting adjustment. The required lighting adjustment is the whole building lighting power assumed in order to calculate the Design Energy Consumption minus the ILPA value from Table 3.4-1 that was used to calculate the Energy Cost Budget. When the required lighting adjustment is less than zero, a complete lighting design must be developed for one or more representative tenant spaces, demonstrating acceptable lighting within the limits of the assumed lighting power allowance.

11.5.9.2 HVAC Systems and Equipment

11.5.9.2.1 If the HVAC system i not completely specified in the plans the Design Energy Consumption shall be based on reasonable assumptions about the construction of future HVAC systems and equipment. These assumptions shall be documented s that future HVAC systems and equipment may be in compliance with these standards.

11.6 The Simulation Tool

11.6.1 Annual energy consumptio shall be simulated with a multi-zo 8760 hours per year building ener model. The model shall account for:

11.6.1.1 The dynamic heat trans of the building envelope such as sol and internal gains;

11.6.1.2 Equipment efficiencies a function of load and climate;

11.6.1.3 Lighting and HVAC syst controls and distribution systems simulating the whole building;

11.6.1.4 The operating schedule of the building including night setback during various times of the year; and

11.6.1.5 Energy consumption information at a level necessary to determine the Energy Cost Budget and Design Energy Cost through the appropriate utility rate schedules.

11.6.2 While the simulation tool should simulate an entire year on an hour by hour basis (8760 hours), programs that approximate this dynamic analysis procedure and provide equivalent results are acceptable.

11.6.3 Simulation tools shall be selected for their ability to simulate accurately the relevant features of the building in question, as shown in the tool's documentation. For example, a single zone model shall not be used to simulate a large, multi-zone building, and a steady-state model such as the degree-day method shall not be used to simulate buildings when equipment efficiency or performance is significantly affected by the dynamic patterns of weather, solar radiation, and occupancy. Relevant energy-related features shall be addressed by a model such as daylighting, atriums or sunspaces, night ventilation or thermal storage, chilled water storage or heat recovery, active or passive solar systems, zoning and controls of heating and cooling systems, and ground-coupled buildings. In addition, models shall be capable of translating the Design Energy Consumption into energy cost using actual utility rate schedules with the coincidental electrical demand of a building. Examples of public domain models capable of handling such complex building systems and energy cost translations available in the United States are DOE-2.1C and BLAST 3.0 and in Canada, Energy Systems Analysis Series.

11.6.4 All simulation tools shall use scientifically justifiable documented techniques and procedures for modeling building loads, systems, and equipment. The algorithms used in the program shall have been verified by comparison with experimental measurements, loads, systems, and equipment.

TABLE 11-1
MULTI-FAMILY HIGH RISE RESIDENTIAL BUILDING SCHEDULES
(INTERNAL LOADS PER DWELLING UNIT Btu/h)

One-Zone Dwelling Unit

	OCCUPANTS		LIGHTS	EQUIPMENT	
HOUR	SENSIBLE	LATENT	SENSIBLE	SENSIBLE	LATENT
1	300	260	0	750	110
2	300	260	0	750	110
3	300	260	0	750	110
4	300	260	0	750	110
5	300	260	0	750	110
6	300	260	0	750	110
7	300	260	980	1250	190
8	210	200	840	2600	420
9	100	80	0	1170	180
10	100	80	0	1270	190
11	100	80	0	1270	190
12	100	80	0	2210	330
13	100	80	0	2210	330
14	100	80	0	1270	190
15	100	80	0	1270	190
16	100	80	0	1270	190
17	100	80	0	1270	190
18	300	260	0	3040	450
19	300	260	0	3360	500
20	300	260	960	1490	220
21	300	260	960	1490	220
22	300	260	960	1490	220
23	300	260	960	1060	160
24	300	260	960	1060	160

TABLE 11-1 (CONT.)
MULTI-FAMILY HIGH RISE RESIDENTIAL BUILDING SCHEDULES
(INTERNAL LOADS PER DWELLING UNIT Btu/h)

Two-Zone Dwelling Unit

HOUR	BEDROOMS & BATHROOMS					OTHER ROOMS				
	OCCUPANTS		LIGHTS	EQUIPMENT		OCCUPANTS		LIGHTS	EQUIPMENT	
	Sensible	Latent	Sensible	Sensible	Latent	Sensible	Latent	Sensible	Sensible	Latent
1	300	260	0	100	20	0	0	0	650	90
2	300	260	0	100	20	0	0	0	650	90
3	300	260	0	100	20	0	0	0	650	90
4	300	260	0	100	20	0	0	0	650	90
5	300	260	0	100	20	0	0	0	650	90
6	300	260	0	100	20	0	0	0	650	90
7	200	180	680	200	40	100	80	300	1050	150
8	110	120	240	200	40	100	80	600	2400	380
9	0	0	0	100	20	100	80	0	1070	160
10	0	0	0	100	20	100	80	0	1170	170
11	0	0	0	100	20	100	80	0	1170	170
12	0	0	0	100	20	100	80	0	2110	310
13	0	0	0	100	20	100	80	0	2110	310
14	0	0	0	100	20	100	80	0	1170	170
15	0	0	0	100	20	100	80	0	1170	170
16	0	0	0	100	20	100	80	0	1170	170
17	0	0	0	100	20	100	80	0	1170	170
18	0	0	0	100	20	300	260	0	2940	430
19	0	0	0	100	20	300	260	0	3260	480
20	100	80	320	300	60	200	180	640	1190	160
21	100	80	320	300	60	200	180	640	1190	160
22	150	130	480	700	90	150	130	480	790	130
23	300	260	640	410	70	0	0	320	650	90
24	300	260	640	410	70	0	0	320	650	90

TABLE 11-2
OCCUPANCY DENSITY

BUILDING TYPE	CONDITIONED FLOOR AREA Ft^2/PERSON
Assembly	50
Office	275
Retail	300
Warehouse	15000
School	75
Hotel/Motel	250
Restaurant	100
Health/Institutional	200
Multi-family High Rise Residential	2 per unit[1]

Heat generation: Btu/h per person: 230 Btu/h per person sensible, and 190 Btu/h per person latent.

[1] See Table 11-1

TABLE 11-3
BUILDING SCHEDULE PERCENTAGE MULTIPLIERS

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
ASSEMBLY OCCUPANCY	WEEKDAY:	0	0	0	0	0	0	0	0	20	20	20	20	80	80	80	80	80	80	20	20	20	20	10	0
	SATURDAY:	0	0	0	0	0	0	0	0	20	20	20	20	60	60	60	60	60	60	60	60	60	80	10	0
	SUNDAY:	0	0	0	0	0	0	0	0	10	10	10	10	10	70	70	70	70	70	70	70	70	70	20	0
ASSEMBLY LTNG & RECEP	WEEKDAY:	0	0	0	0	0	0	40	40	40	75	75	75	75	75	75	75	75	75	75	75	75	75	25	0
	SATURDAY:	0	0	0	0	0	0	0	30	30	50	50	50	50	50	50	50	50	50	50	50	50	50	0	0
	SUNDAY:	0	0	0	0	0	0	0	30	30	30	30	30	65	65	65	65	65	65	65	65	65	65	0	0
ASSEMBLY HVAC	WEEKDAY:	OFF	OFF	OFF	OFF	OFF	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	OFF
	SATURDAY:	OFF	OFF	OFF	OFF	OFF	OFF	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	OFF
	SUNDAY:	OFF	OFF	OFF	OFF	OFF	OFF	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	OFF
ASSEMBLY SWH	WEEKDAY:	0	0	0	0	0	0	0	0	0	5	5	35	5	5	5	5	5	0	0	0	0	0	0	0
	SATURDAY:	0	0	0	0	0	0	0	0	0	5	5	20	0	0	0	0	0	0	0	65	30	0	0	0
	SUNDAY:	0	0	0	0	0	0	0	0	0	5	5	10	0	0	0	0	0	0	0	65	30	0	0	0
OFFICE OCCUPANCY	WEEKDAY:	0	0	0	0	0	0	0	10	20	95	95	45	45	95	95	95	95	95	30	10	10	10	0	0
	SATURDAY:	0	0	0	0	0	0	0	10	10	30	30	30	30	10	10	10	10	10	0	0	0	0	0	0
	SUNDAY:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
OFFICE LTNG & RECEP	WEEKDAY:	0	0	0	0	0	0	10	30	90	90	90	90	80	90	90	90	90	90	30	30	20	20	0	0
	SATURDAY:	0	0	0	0	0	0	10	10	30	30	30	30	15	15	15	15	15	15	0	0	0	0	0	0
	SUNDAY:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
OFFICE HVAC	WEEKDAY:	OFF	OFF	OFF	OFF	OFF	OFF	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	OFF	OFF	OFF	OFF	OFF	OFF
	SATURDAY:	OFF	OFF	OFF	OFF	OFF	OFF	OFF	ON	ON	ON	ON	ON	ON	ON	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
	SUNDAY:	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
OFFICE SWH	WEEKDAY:	0	0	0	0	0	0	0	15	30	35	35	45	55	50	30	30	40	20	20	10	15	5	0	0
	SATURDAY:	0	0	0	0	0	0	0	10	10	20	15	20	15	15	10	10	10	0	0	0	0	0	0	0
	SUNDAY:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

TABLE 11-3 (Continued)

BUILDING SCHEDULE PERCENTAGE MULTIPLIERS

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
RETAIL OCCUPANCY	WEEKDAY:	0	0	0	0	0	0	0	10	20	50	50	70	70	70	70	80	70	50	50	30	30	0	0	0
	SATURDAY:	0	0	0	0	0	0	0	10	20	50	60	80	80	80	80	80	80	60	20	20	20	10	0	0
	SUNDAY:	0	0	0	0	0	0	0	0	0	10	20	20	40	40	40	60	40	20	10	0	0	0	0	0
RETAIL LTNG & RECEP	WEEKDAY:	0	0	0	0	0	0	0	20	50	90	90	90	90	90	90	90	90	90	60	60	50	0	0	0
	SATURDAY:	0	0	0	0	0	0	0	10	30	60	90	90	90	90	90	90	90	90	50	30	30	10	0	0
	SUNDAY:	0	0	0	0	0	0	0	0	0	10	40	40	60	60	60	60	60	40	20	0	0	0	0	0
RETAIL HVAC	WEEKDAY:	OFF	OFF	OFF	OFF	OFF	OFF	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	OFF	OFF	OFF
	SATURDAY:	OFF	OFF	OFF	OFF	OFF	OFF	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	OFF	OFF
	SUNDAY:	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	OFF	OFF	OFF	OFF	OFF
RETAIL SWH	WEEKDAY:	0	0	0	0	0	0	0	10	20	30	40	55	60	60	45	40	45	45	40	30	30	0	0	0
	SATURDAY:	0	0	0	0	0	0	0	15	20	25	40	50	55	55	45	45	45	45	40	35	25	20	0	0
	SUNDAY:	0	0	0	0	0	0	0	0	0	10	25	30	35	35	30	30	35	30	20	0	0	0	0	0
WAREHOUSE OCCUPANCY	WEEKDAY:	0	0	0	0	0	0	0	15	70	90	90	90	50	85	85	85	20	0	0	0	0	0	0	0
	SATURDAY:	0	0	0	0	0	0	0	0	20	20	20	20	10	10	10	10	0	0	0	0	0	0	0	0
	SUNDAY:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WAREHOUSE LTNG & RECEP	WEEKDAY:	0	0	0	0	0	0	0	40	70	90	90	90	90	90	90	90	90	0	0	0	0	0	0	0
	SATURDAY:	0	0	0	0	0	0	0	0	10	25	25	25	10	10	10	10	0	0	0	0	0	0	0	0
	SUNDAY:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WAREHOUSE HVAC	WEEKDAY:	OFF	OFF	OFF	OFF	OFF	OFF	OFF	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	OFF	OFF	OFF	OFF	OFF	OFF	OFF
	SATURDAY:	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	ON	ON	ON	ON	ON	ON	ON	ON	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
	SUNDAY:	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
WAREHOUSE SWH	WEEKDAY:	0	0	0	0	0	0	0	5	25	35	35	45	55	50	35	50	15	0	0	0	0	0	0	0
	SATURDAY:	0	0	0	0	0	0	0	0	0	10	10	15	0	0	0	0	0	0	0	0	0	0	0	0
	SUNDAY:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

TABLE 11-3 (Continued)
BUILDING SCHEDULE PERCENTAGE MULTIPLIERS

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
SCHOOL OCCUPANCY	WEEKDAY:	0	0	0	0	0	0	0	5	75	90	90	80	80	80	80	45	15	5	15	20	20	10	0	0
	SATURDAY:	0	0	0	0	0	0	0	0	10	10	10	10	10	0	0	0	0	0	0	0	0	0	0	0
	SUNDAY:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SCHOOL LTNG & RECEP	WEEKDAY:	0	0	0	0	0	0	0	30	85	95	95	95	80	80	80	70	50	50	35	35	35	30	0	0
	SATURDAY:	0	0	0	0	0	0	0	0	15	15	15	15	15	0	0	0	0	0	0	0	0	0	0	0
	SUNDAY:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SCHOOL HVAC	WEEKDAY:	OFF	OFF	OFF	OFF	OFF	OFF	OFF	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
	SATURDAY:	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	ON	ON	ON	ON	ON	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
	SUNDAY:	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
SCHOOL SWH	WEEKDAY:	0	0	0	0	0	0	0	5	30	55	60	70	75	80	60	60	5	5	15	20	20	20	0	0
	SATURDAY:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	SUNDAY:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HOTEL/MOTEL OCCUPANCY	WEEKDAY:	90	90	90	90	90	90	70	40	40	20	20	20	20	20	20	30	50	50	50	70	70	80	90	90
	SATURDAY:	90	90	90	90	90	90	70	50	50	30	30	30	30	30	30	30	30	50	60	60	60	70	70	70
	SUNDAY:	70	70	70	70	70	70	70	70	50	50	50	30	30	20	20	20	30	40	40	60	60	80	80	80
HOTEL/MOTEL LTNG & RECEP	WEEKDAY:	20	15	10	10	10	20	40	50	40	40	25	25	25	25	25	25	25	25	60	80	90	80	60	30
	SATURDAY:	20	20	10	10	10	10	30	30	40	40	30	25	25	25	25	25	25	25	60	70	70	70	60	30
	SUNDAY:	30	30	20	20	20	20	30	40	40	30	30	30	30	20	20	20	20	20	50	70	80	60	50	30
HOTEL/MOTEL HVAC	WEEKDAY:	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
	SATURDAY:	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
	SUNDAY:	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
HOTEL/MOTEL SWH	WEEKDAY:	20	15	15	15	20	25	50	60	55	45	40	45	40	35	30	30	30	40	55	60	50	55	45	25
	SATURDAY:	20	15	15	15	20	25	40	50	50	50	45	50	50	45	40	40	34	40	55	55	50	55	40	30
	SUNDAY:	25	20	20	20	20	30	50	50	50	55	50	50	40	40	30	30	30	40	50	50	40	50	40	20

TABLE 11-3 (Continued)

BUILDING SCHEDULE PERCENTAGE MULTIPLIERS

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
RESTAURANT OCCUPANCY	WEEKDAY:	15	15	5	0	0	0	0	5	5	5	20	50	80	70	40	20	25	50	80	80	80	50	35	20
	SATURDAY:	30	25	5	0	0	0	0	0	0	5	20	45	50	50	35	30	30	30	70	90	70	65	55	35
	SUNDAY:	20	20	5	0	0	0	0	0	0	0	0	20	25	25	15	20	25	35	55	65	70	35	20	20
RESTAURANT LTNG & RECEP	WEEKDAY:	15	15	15	15	15	20	40	40	60	60	90	90	90	90	90	90	90	90	90	90	90	90	50	30
	SATURDAY:	20	15	15	15	15	15	30	30	60	60	80	80	80	80	80	80	80	90	90	90	90	90	50	30
	SUNDAY:	20	15	15	15	15	15	30	30	50	70	70	70	70	70	70	70	60	60	60	60	60	60	50	30
RESTAURANT HVAC	WEEKDAY:	ON	ON	ON	OFF	OFF	OFF	OFF	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
	SATURDAY:	ON	ON	ON	OFF	OFF	OFF	OFF	ON	OFF	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
	SUNDAY:	ON	ON	ON	OFF	OFF	OFF	OFF	OFF	OFF	OFF	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
RESTAURANT SWH	WEEKDAY:	20	15	15	0	0	0	0	60	55	45	40	45	40	35	30	30	30	40	55	60	50	55	45	25
	SATURDAY:	20	15	15	0	0	0	0	0	0	50	45	50	50	45	40	40	35	40	55	55	50	55	40	30
	SUNDAY:	25	20	20	0	0	0	0	0	0	0	50	50	40	40	30	30	30	40	50	50	40	50	40	20
HEALTH OCCUPANCY	WEEKDAY:	0	0	0	0	0	0	0	10	50	80	80	80	80	80	80	80	80	50	30	30	20	20	0	0
	SATURDAY:	0	0	0	0	0	0	0	10	30	40	40	40	40	40	40	40	40	10	10	0	0	0	0	0
	SUNDAY:	0	0	0	0	0	0	0	0	5	5	5	5	5	5	5	5	5	0	0	0	0	0	0	0
HEALTH LTNG & RECEP	WEEKDAY:	0	0	0	0	0	0	0	50	90	90	90	90	90	90	90	90	90	30	30	30	30	30	0	0
	SATURDAY:	0	0	0	0	0	0	0	20	40	40	40	40	40	40	40	40	40	40	10	0	0	0	0	0
	SUNDAY:	0	0	0	0	0	0	0	0	10	10	10	10	10	10	10	10	0	0	0	0	0	0	0	0
HEALTH SWH	WEEKDAY:	0	0	0	0	0	0	0	15	55	60	75	80	70	80	75	70	60	40	15	15	15	5	0	0
	SATURDAY:	0	0	0	0	0	0	0	0	15	25	25	25	20	20	20	20	20	5	0	0	0	0	0	0
	SUNDAY:	0	0	0	0	0	0	0	0	0	15	15	15	15	15	15	0	0	0	0	0	0	0	0	0
HEALTH HVAC	WEEKDAY:	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
	SATURDAY:	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
	SUNDAY:	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
MULTI-FAMILY SWH SYSTEM	WEEKDAY:	0	0	0	5	5	5	80	70	50	40	20	20	25	25	30	50	70	70	35	20	15	15	5	0
	SATURDAY:	0	0	0	0	0	0	20	45	50	50	35	30	30	30	70	90	70	65	55	35	30	25	5	0
	SUNDAY:	0	0	0	0	0	0	0	20	25	25	15	20	25	25	55	60	70	35	20	20	20	20	5	0

NOTES FOR TABLE 11-3

1 Reference: Recommendations for Energy Conservation Standards and Guidelines for New Commercial Buildings, Vol. III, App. A Pacific Northwest Laboratory, PNL-4870-8, 1983."

2 Table 11-3 contains multipliers for converting the nominal values for building occupancy (Table 11-2), receptacle power density (Table 11-4), service hot water (Table 11-6), and lighting energy (Section 3.4 or 3.5) into time series data for estimating building loads under the Standard Calculation Procedure.

For each standard building profile there are three series - one each for weekdays, Saturday and Sunday. There are 24 elements per series. These represent the multiplier that should be used to estimate building loads from 12 a.m. to 1 a.m. (series element #1) through 11 p.m. to 12 a.m. (series element #24). The estimated load for any hour is simply the multiplier from the appropriate standard profile multiplied by the appropriate value from the tables cited above.

3 The Building HVAC System Schedule listed in Table 11-3 lists the hours when the HVAC system shall be considered "on" or "off" in accordance with Section 11.5.5.2.

TABLE 11-4
RECEPTACLE POWER DENSITIES

BUILDING TYPE	W/ft^2 OF CONDTIONED FLOOR AREA
Assembly	0.25
Office	0.75
Retail	0.25
Warehouse	0.1
School	0.5
Hotel/Motel	0.25
Restaurant	0.1
Health	1.0
Multi-Family High Rise Residential	Included in Lights and Equipment portions of Table 11-1

TABLE 11-5

HVAC SYSTEMS OF PROTOTYPE AND REFERENCE BUILDINGS[1, 2]

BUILDING/SPACE OCCUPANCY	SYSTEM NO. (TABLE 11-7)	REMARKS (TABLE 11-7)
Assembly		
a. Churches (any size)	1	
b. ≤50,000 ft^2 or ≤3 floors	1 or 3	Note 1
c. >50,000 ft^2 or >3 floors	3	
Office		
a. ≤20,000 ft^2	1	
b. >20,000 ft^2 and either ≤3 floors or ≤75,000 ft^2	4	
c. >75,000 ft^2 or >3 floors	5	
Retail		
a. ≤50,000 ft^2	1 or 3	Note 1
b. >50,000 ft^2	4 or 5	Note 1
Warehouse	1	Note 1
Schools		
a. ≤75,000 ft^2 or ≤3 floors	1	
b. >75,000 ft^2 or >3 floors	3	
Hotel/Motel		
a. ≤3 stories	2 or 7	Note 5, 7
b. >3 stories	6	Note 6
Restaurant	1 or 3	Note 1
Health		
a. Nursing Home (any size)	2 or 7	Note 7
b. ≤15,000 ft^2	1	
c. >15,000 ft^2 and ≤50,000 ft^2	4	Note 2
d. >50,000 ft^2	5	Note 2, 3
Multi-Family High Rise Residential >3 stories	7	

[1] Space and Service Water Heating budget calculations shall be made using both electricity and natural gas. The Energy Cost Budget shall be the lower of these two calculations. If natural gas is not available at the rate, electricity and #2 fuel oil shall be used for the budget calculations.

[2] The systems and energy types presented in this Table are not intended as requirements or recommendations for the proposed design. Floor areas below are the total conditioned floor areas for the listed occupancy type in the building. The number of floors indicated below is the total number of occupied floors for the listed occupancy type.

TABLE 11-6
SERVICE HOT WATER QUANTITIES

Building Type	Btu/Person-hour[1]
1. Assembly	215
2. Office	175
3. Retail	135
4. Warehouse	225
5. School	215
6. Hotel/Motel	1110
7. Restaurant	390
8. Health	135
9. Multi-Family High Rise Residential	1700[2]

1. This value is the number to be multiplied by the percentage multipliers of the building profile schedules in Table 11-4. See Table 11-2 for occupancy levels.

2. Total hot water use per dwelling unit for each hour shall be 3400 Btu/h times the multi-family high rise residential building SWH system multiplier from Table 11-3.

TABLE 11-7

HVAC SYSTEM DESCRIPTION FOR PROTOTYPE AND REFERENCE BUILDINGS[1, 2]

HVAC COMPONENT	SYSTEM #1	SYSTEM #2	SYSTEM #3	SYSTEM #4
System Description	Packaged rooftop single zone, one unit per zone	Packaged terminal air conditioner with space heater or heatpump, one heating/cooling unit per zone	Air handler per zone with central plant	Packaged rooftop VAV w/perimeter reheat
Fan System Design supply circulation rate	Note 9	Note 10	Note 9	Note 9
Supply fan total static pressure	1.3 in. W.C.	N/A	2.0 in. W.C.	3.0 in. W.C.
Combined supply fan, motor, and drive efficiency	40%	N/A	50%	45%
Supply fan control	Constant volume	Fan Cycles with call for heating or cooling	Constant volume	VAV w/forward curved centrifugal fan and variable inlet vanes
Return fan total static pressure	N/A	N/A	0.6 in. W.C.	0.6 in. W.C.
Combined return fan, motor, and drive efficiency	N/A	N/A	25%	25%
Return fan control	N/A	N/A	Constant volume	VAV w/forward curved centrifugal fan and discharge dampers
Cooling System	Direct expansion air cooled	Direct expansion air cooled	Chilled water (Note 11)	Direct expansion air cooled
Heating System	Furnace, heatpump, or electric resistance (Note 8)	Heatpump w/electric resistance auxiliary or air conditioner w/space heater (Note 8)	Hot water (Note 8, 12)	Hot water (Note 12) or electric resistance (Note 8)
Remarks	Drybulb economizer per Section 7.4.3 (barometric relief)	No economizer	Drybulb economizer per Section 7.4.3	Drybulb economizer per Section 7.4.3 Minimum VAV setting per 7.4.3 exception 1. Supply air reset by zone of greatest cooling demand.

Notes:

1. The systems and energy types presented in this Table are not intended as requirements or recommendations for the proposed design.

2. For numbered notes see end of Table 11-7.

TABLE 11-7, (Continued)
HVAC SYSTEM DESCRIPTION FOR PROTOTYPE AND REFERENCE BUILDINGS[1]

HVAC COMPONENT	SYSTEM #5	SYSTEM #6	SYSTEM #7
System Description	Built-up central VAV with perimeter reheat	Four-pipe fan coil per zone with central plant	Water source heat pump
Fan System Design supply circulation rate	Note 9	Note 9	Note 10
Supply fan total static pressure	4.0 in. W.C.	0.5 in. W.C.	0.5 in. W.C.
Combined supply fan, motor, and drive efficiency	55%	25%	25%
Supply fan control	VAV w/air-foil centrifugal fan and AC frequency variable speed drive	Fan cycles w/call for heating or cooling	Fan cycles w/call for heating or cooling
Return fan total static pressure	1.0 in. W.C.	N/A	N/A
Combined return fan, motor, and drive efficiency	30%	N/A	N/A
Return fan control	VAV with air-foil centrifugal fan and AC frequency variable speed drive	N/A	N/A
Cooling System	Chilled water (Note 11)	Chilled water (Note 11)	Closed circuit, centrifugal centrifugal blower type cooling tower sized per Note 11. Circulating pump sized for 2.7 GPM per ton.
Heating System	Hot water (Note 12) or electric resistance (Note 8)	Hot water (Note 12) or electric resistance (Note 8)	Electric or natural draft fossil fuel boiler (Note 8)
Remarks	Drybulb economizer per Section 7.4.3 Minimum VAV setting per Section 7.4.4.3 Supply air reset by zone of greatest cooling demand.	No economizer	Tower fans and boiler cycled to maintain circulating water temperature between 60 and design tower leaving water temperature.

TABLE 11-7

NUMBERED NOTES FOR TABLE 11-7

HVAC SYSTEM DESCRIPTIONS FOR PROTOTYPE AND REFERENCE BUILDINGS

NOTES:

1. For occupancies such as restaurants, assembly and retail which are part of a mixed use building which, according to Table 11-7, includes a central chilled water plant (systems 3, 5, or 6), chilled water system type 3 or 5, as indicated in the Table, shall be used.

2. Constant volume may be used in zones where pressurization relationships must be maintained by code. VAV shall be used in all other areas, in accordance with Section 7.4.4.3.

3. Provide run-around heat recovery systems for all fan systems with minimum outside air intake greater than 75%. Recovery effectiveness shall be 0.60.

4. If a warehouse is not intended to be mechanically cooled, both the Energy Cost Budgets and Design Energy Costs, may be calculated assuming no mechanical cooling.

5. The system listed is for guest rooms only. Areas such as public areas and back-of-house areas shall be served by system 4. Other areas such as offices and retail shall be served by the systems listed in Table 11-7 for these occupancy types.

6. The system listed is for guest rooms only. Areas such as public areas and back-of-house areas shall be served by system 5. Other areas such as offices and retail shall be served by systems listed in Table 11-7 for these occupancy types.

7. System 2 shall be used for the Energy Cost Budget calculation except in areas with design heating outside air temperatures less than 10 °F.

8. Prototype energy budget cost calculations shall be made using both electricity and natural gas. If natural gas is not available at the site, electricity and #2 fuel oil shall be used. The Energy Cost Budget shall be the lower of these results. Alternately, the Energy Cost Budget may be based on the fuel source that minimizes total operating, maintenance, equipment, and installation costs for the prototype over the building lifetime. Equipment and installation cost estimates shall be prepared using professionally recognized cost estimating tools, guides, and techniques. The methods of analysis shall conform to those of Subpart A of 10 CFR 436. Energy costs shall be based on actual costs to the building as defined in this Section.

9. Design supply air circulation rate shall be based on a supply air to room air temperature difference of 20 °F. A higher supply air temperature may be used if required to maintain a minimum circulation rate of 4.5 air changes per hour or 15 cfm per person at design conditions to each zone served by the system. If return fans are specified, they shall be sized from the supply fan capacity less the required minimum ventilation with outside air, or 75% of the supply air capacity, whichever is larger. Except where noted, supply and return fans shall be operated continuously during occupied hours.

10. Fan Energy When included in the efficiency rating of the unit as defined in Section 7.4.4.3 need not be modeled explicitly for this system. The fan shall cycle with calls for heating or cooling.

11. Chilled water systems shall be modeled using a reciprocating chiller for systems with total cooling capacities less than 175 tons, and centrifugal chillers for systems with cooling capacities of 175 tons or greater. For systems with cooling of 600 tons or more, the Energy Cost Budget shall be calculated using two centrifugal chillers lead/lag controlled. Chilled water pumps shall be sized using a 12 °F temperature rise, from 44 °F to 56 °F, operating at 75 feet of head and and 65% combined impeller and motor efficiency. Condenser water pumps shall be sized using a 10 °F temperature rise, operating at 60 feet of head and 60% combined impeller and motor efficiency. The cooling tower shall be an open circuit, centrifugal blower type sized for the larger of 85 °F leaving water temperature or 10 °F approach to design wetbulb temperature. The tower shall be controlled to provide a 65 °F leaving water temperature whenever weather conditions permit, floating up to design leaving water temperature at design conditions. Chilled water supply temperature shall be reset in accordance with Section 7.4.6.2.

12. Hot water system shall include a natural draft fossil fuel or electric boiler per Note 8. The hot water pump shall be sized based on a 30 °F temperature drop, for 180 °F to 150 °F, operating at 60 feet of head and a combined impeller and motor efficiency of 60%. Hot water supply temperature shall be reset in accordance with Section 7.4.6.2.

TABLE 11-8

THERMOSTAT SETTINGS FOR MULTI-FAMILY HIGH-RISE BUILDINGS

TIME OF DAY	SINGLE ZONE DWELLING UNIT		TWO ZONE DWELLING UNIT			
			BEDROOMS/BATHROOMS		OTHER ROOMS	
	HEAT	COOL	HEAT	COOL	HEAT	COOL
Midnight - 6 a.m.	60	78	60	78	60	85
6 a.m. - 9 a.m.	70	78	70	78	70	78
9 a.m. - 5 p.m.	70	78	60	85	70	78
5 p.m. - 11 p.m.	70	78	70	78	70	78
11 p.m. - Midnight	60	78	60	78	60	78

§ 435.112 Building energy compliance alternative.

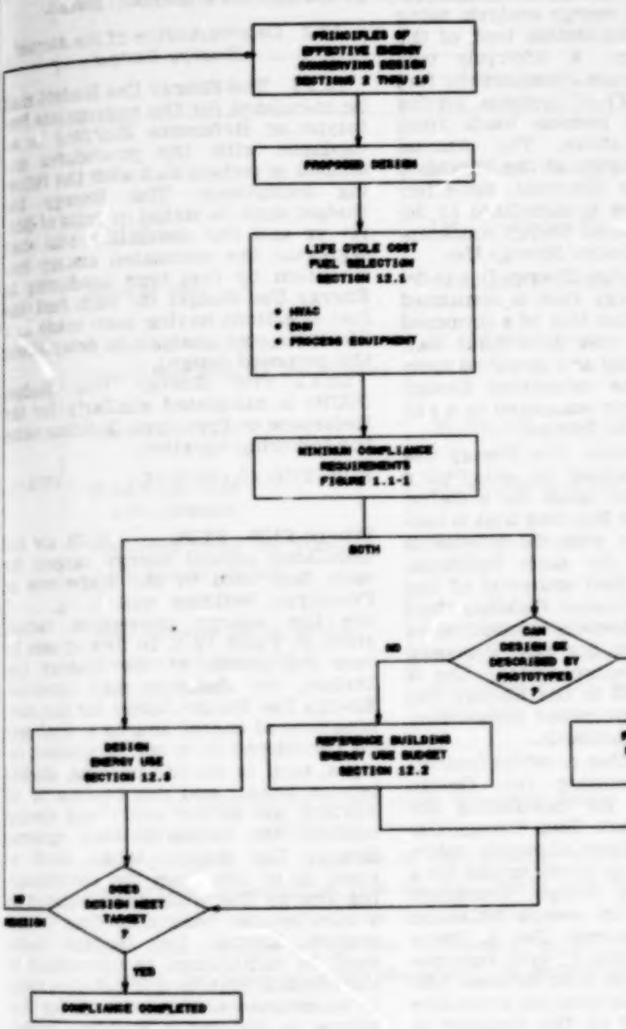
12.1 General

12.1 This section provides an alternative path for compliance with the standards that allow for greater flexibility in the design of energy efficient buildings using an annual energy target method. This path, as does the path used in section 11.0, provides an opportunity for the use of innovative designs, materials, and equipment such as daylighting, passive solar heating, heat recovery, and thermal storage as well as other applications of off-peak electrical energy where they cannot be adequately evaluated by the prescriptive or system performance methods found in sections 3.4, 3.5, 5.4, 5.5, 7.4., and 9.4.

12.1.2 The Building Energy Use Budget Target alternative may be used as an option to the Building Energy Cost Budget method in Section 11.0 and is to be used in lieu of the prescriptive and system performance methods and in conjunction with sections 3.3, 4.3, 5.3, 6.3, 7.3, 8.3, 9.3 and 10.3.

12.1.3 Compliance under this section is demonstrated by showing that the calculated annual energy usage for the Proposed Design is less than or equal to a calculated Energy Use Budget. (See Figure 12-1). A life-cycle cost economic analysis is required to evaluate alternative fuel sources and energy reduction strategies. The procedures in this chapter are intended only for establishing design compliance, and are not intended to be used either to predict, document or verify annual energy consumption or annual energy costs.

Figure 12-1 Building Energy Compliance Alternative


PRINCIPLES OF EFFECTIVE ENERGY CONSERVING DESIGN SECTIONS 2 THRU 10
PROPOSED DESIGN
LIFE CYCLE COST FUEL SELECTION SECTION 12.1
• HVAC
• SHW
• PROCESS EQUIPMENT
MINIMUM COMPLIANCE REQUIREMENTS FIGURE 1.1-1
BOTH
NO
CAN DESIGN BE DESCRIBED BY PROTOTYPES ?
YES
DESIGN ENERGY USE SECTION 12.3
REFERENCE BUILDING ENERGY USE BUDGET SECTION 12.2
PROTOTYPE BUILDING ENERGY USE BUDGET SECTION 12.2
NO
EDESIGN
DOES DESIGN MEET TARGET ?
YES
COMPLIANCE COMPLETED

12.1.4 Compliance under the Building Energy Use Budget method requires a detailed energy analysis, using a conventional simulation tool, of the Proposed Design. A life-cycle cost analysis shall be used to select the fuel source for the HVAC systems, service hot water, and process loads from available alternatives. The Annual Energy Consumption of the Proposed Design with the life-cycle cost-effective fuel selection is calculated to determine the modeled energy consumption, called the Design Energy Use.

12.1.5 The Design Energy Use is defined as the energy that is consumed within the five foot line of a proposed building per ft² over a 24 hour day, 365-day year period and specified operating hours. The calculated Design Energy Use is then compared to a calculated Energy Use Budget.

12.1.6 *Compliance.* The Energy Use Budget is determined by calculating the annual energy usage for a Reference or Prototype Building that is configured to comply with the provisions of Section 11.0 for such buildings, except that the fuel source(s) of the Prototype or Reference Building shall be the same life-cycle cost-effective source(s) selected for the Proposed Design. If the Design Energy Use is less than or equal to the Energy Use Budget then the proposed design complies with these standards.

12.1.7 This section provides instructions for determining the Design Energy Use and for calculating the Energy Use Budget. The Energy Use Budget is the highest allowable calculated annual energy consumption for a specified building design. Designers are encouraged to design buildings whose Design Energy Use is lower than the Energy Use Budget. Incorporated in this section is an optional life-cycle cost economic analysis procedure that may be used by the designer to examine the economic feasibility of all energy design alternatives and to produce a more optimum design.

12.2 Determination of the Annual Energy Budget

12.2.1 The Energy Use Budget shall be calculated for the appropriate Prototype or Reference Building in accordance with the procedures prescribed in section 11.2 with the following exceptions: The Energy Use Budget shall be stated in units of Btu/ft² yr and the simulation tool shall segregate the calculated energy consumption by fuel type producing an Energy Use Budget for each fuel (the fuel selections having been made by a life cycle cost analysis in determining the proposed design).

12.2.2 The Energy Use Budget (EUB) is calculated similarly for the Reference or Prototype Building using the following equation:

$$EUB = EUB_1 \times f_1 + EUB_2 \times f_2 + \ldots\ldots + EUB_i \times f_i$$

Equation 12-1

Where EUB_1, EUB_2, . . . EUB_i are the calculated annual energy targets for each fuel used in the Reference or Prototype building and f_1, f_2, . . . f_i are the energy conversion factors given in Table 12-1. In lieu of case by case calculation of the Energy Use Budget, the designer may construct Energy Use Budget tables for the combinations of energy source(s) that may be considered in a set of project designs, such as electric heating, electric service water, and gas cooling or oil heating, gas service water and electric cooling. The values in such optional Energy Use Budget tables shall be equal to or less than the corresponding Energy Use Budgets calculated on a case by case basis according to this section. Energy Use Budget tables shall be constructed to correspond to the climatic regions and building types in accordance with provisions for Prototype or Reference Building models in Section 11.0 of these standards.

TABLE 12-1

FUEL CONVERSION FACTORS FOR COMPUTING DESIGN ANNUAL ENERGY USES

FUELS	CONVERSION FACTOR
Electricity	3412 Btu/kilowatt hour
Fuel Oil	138,700 Btu/gallon
Natural Gas	1,031,000 Btu/1000 ft^3
Liquified Petroleum (including Propane and Butane)	95,500 Btu/gallon
Anthracite Coal	28,300,000 Btu/short ton
Bituminous Coal	24,580,000 Btu/short ton
Purchased Steam and Steam from Central Plants	1,000 Btu/Pound
High Temperature or Medium Temperature Water from Central Plants	Use the heat value based on the water actually delivered at the building five foot line

NOTE: At specific locations where the energy source Btu content varies significantly from the value presented above then the local fuel value may be used provided there is supporting documentation from the fuel source supplier stating this actual fuel energy value and verifying that this value will remain consistent for the foreseeable future. The fuel content for fuels not given above shall be determined from the best available source.

12.3 Determination of the Design Energy Use

12.3.1 The Design Energy Use shall be calculated by modeling the Proposed Design using the same methods, assumptions, climate data, and simulation tool as were used to establish the Energy Use Budget, but with the design features that will be used in the final building design. The simulation tool used shall segregate the calculated energy consumption by fuel type giving an annual Design Energy Use for each fuel. The sum of the Design Energy Uses multiplied by the fuel conversion factors in Table 12-1 yields the Design Energy Use for the proposed design:

$$DEU = DEU_1 \times f_1 + DEU_2 \times f_2 + \ldots . + DEU_i \times f_i$$

Equation 12-2

Where $f_1, f_2, \ldots f_i$ are the fuel conversion factors in Table 12-1.

12.3.2 Required Life Cycle Cost Analysis for Fuel Selection

12.3.2.1 Fuel sources selected for the Proposed Design and Prototype or Reference buildings shall be determined by considering the energy cost and other costs and benefits that occur during the expected economic life of the alternative.

12.3.2.2 The designer shall use the procedures set forth in Subpart A of 10 CFR Part 436 to make this determination. The fuel selection life cycle cost analysis shall include the following steps:

12.3.2.2.1 Determine the feasible alternatives for energy sources of the Proposed Design's HVAC systems, service hot water, and process loads.

12.3.2.2.2 Model the Proposed Design including the alternative HVAC and service water systems and conduct an annual energy analysis for each fuel source alternative using the simulation tool specified in this section. The annual energy analysis shall be computed on a monthly basis in conformance with section 11.0 of these standards with the exception that all process loads shall be included in the calculation. Separate the output of the analysis by fuel type.

12.3.2.2.3 Determine the unit price of each fuel using information from the utility or other reliable local source. During rapid changes in fuel prices it is recommended that an average fuel price for the previous twelve months be used in lieu of the current price. Calculate the annual energy cost of each energy source alternative in accordance with procedures in Section 11.0 for the Design Energy Cost. Estimate the initial cost of the HVAC and service water systems and other initial costs such as energy distribution lines and service connection fees associated with each fuel source alternative. Estimate other costs and benefits for each alternative including, but not necessarily limited to, annual maintenance and repair, periodic and one time major repairs and replacements and salvage of the energy and service water systems. Cost estimates shall be prepared using professionally recognized cost estimating tools, guides and techniques.

12.3.2.2.4 Perform a life cycle cost analysis using the procedure specified in section 12.3.2.

12.3.2.2.5 Compare the total life cycle cost of each energy source alternative. The alternative with the lowest total life-cycle cost shall be chosen as the energy source for the proposed design.

12.4 Compliance

12.4.1 Compliance with this section is demonstrated if the Design Energy Use is equal to or less than the Energy Use Budget.

$$DEU < EUB$$

Equation 12-3

12.4.2 The energy consumption shall be measured at the building five foot line for all fuels. Energy consumed from non-depletable energy sources and heat recovery systems shall not be included in the Design Energy Use calculations. The thermal efficiency of fixtures, equipment, systems or plants in the proposed design shall be simulated by the selected calculation tool.

12.5 Standard Calculation Procedure

12.5.1 The Standard Calculation Procedure consists of methods and assumptions for calculating the Energy

Use Budgets for Prototype and Reference Buildings and the Design Energy Use for the Proposed Design. In order to maintain consistency between the Energy Use Budgets and the Design Energy Use, the input assumptions stated in section 11.5 are to be used.

12.5.2 The terms Energy Cost Budget and Design Energy Cost or Consumption used in section 11.0 correlate to Energy Use Budget and Design Energy Use, respectively, in section 12.0.

12.6 The Simulation Tool

12.6.1 The criteria established in Section 11.0 for the selection of a simulation tool shall be followed when using the compliance path prescribed in Section 12.0.

12.7 Life Cycle Cost Analysis Criteria

12.7.1 The following life cycle cost criteria applies to the fuel selection requirements of this chapter and to option life cycle cost analyses performed to evaluate energy conservation design alternatives. The fuel source(s) selection shall be made in accordance with the requirements of Subpart A of 10 CFR Part 436. The implementation calculations for the methodology of Subpart A of 10 CFR Part 436 is provided in *National Bureau of Standards Handbook 135* entitled "Life Cycle Cost Manual for the Federal Energy Management Program." When performing life cycle cost analyses of optional energy conservation opportunities the designer may use the life cycle cost procedures of *Subpart A of 10 CFR Part 436 or OMB Circular A-94* or an equivalent procedure that meets the assumptions listed below:

12.7.1.1 The economic life of the Prototype Building and Proposed Design shall be 25 years. Anticipated replacements or renovations of energy related features and systems in the Prototype or Reference Building and Proposed Design during this period shall be included in their respective life cycle cost calculations.

12.7.1.2 The designer shall follow established professional cost estimating practices when determining the costs and benefits associated with the energy related features of the Prototype or Reference Building and Proposed Design.

12.7.1.3 All costs shall be expressed in current dollars. General inflation shall be disregarded. Differential escalation of prices (prices estimated to rise faster or slower than general inflation) for energy used in the life cycle cost calculations shall be those in effect at the time of the life cycle cost calculations as published by the Department of Energy's Energy Information Administration.

12.7.1.4 The economic effects of taxes, depreciation and other factors not consistent with the practices of *Subpart A of 10 CFR Part 436* shall not be included in the life cycle cost calculation.

Subpart B—Voluntary Performance Standards for New Non-Federal Residential Buildings [Reserved]

Subpart C—Mandatory Performance Standards for New Federal Residential Buildings

§ 435.300 Purpose.

(a) This subpart establishes voluntary energy conservation performance standards for new residential buildings. The voluntary energy conservation performance standards are designed to achieve the maximum practicable improvements in energy efficiency and increases in the use of non-depletable sources of energy.

(b) Voluntary energy conservation performance standards prescribed under this subpart shall be developed solely as guidelines for the purpose of providing technical assistance for the design of energy conserving buildings, and shall be mandatory only for the design of Federal buildings.

(c) The energy conservation performance standards will direct Federal policies and practices to ensure that cost-effective energy conservation features will be incorporated into the designs of all new residential buildings designed and constructed by and for Federal agencies.

§ 435.301 Scope.

(a) The energy conservation performance standards for new Federal residential buildings will apply to the design of all new residential buildings except multifamily buildings more than three stories above grade.

(b) The primary types of buildings built by or for the Federal agencies, to which the energy conservation performance standards will apply, are:

(1) Single-story single-family residences;

(2) Split-level single-family residences;

(3) Two-story single-family residences;

(4) End-unit townhouses;

(5) Middle-unit townhouses;

(6) End-units in multifamily buildings (of three stories above grade or less);

(7) Middle-units in multifamily buildings (of three stories above grade or less);

(8) Single-section mobile homes; and

(9) Multi-section mobile homes.

§ 435.302 Definitions.

(a) "Building" means any new residential structure (1) that includes or will include a heating or cooling system, or both, or a domestic hot water system, and (2) for which a building design is created after the effective date of this rule.

(b) "Building design" means the development of plans and specifications for human living space.

(c) "Conservation Optimization Standard for Savings in Federal Residences" means the computerized calculation procedure that is used to establish an energy consumption goal for the design of Federal residential buildings.

(d) "COSTSAFR" means the Conservation Optimization Standard for Savings in Federal Residences.

(e) "Energy conservation voluntary performance standard" means an energy consumption goal or goals to be met without specification of the method, materials, and processes to be employed in achieving that goal or goals, but including statements of the requirements, criteria and evaluation methods to be used, and any necessary commentary.

(f) "Federal agency" means any department, agency, corporation, or other entity or instrumentality of the executive branch of the Federal Government, including the United States Postal Service, the Federal National Mortgage Association, and the Federal Home Loan Mortgage Corporation.

(g) "Federal residential building" means any residential building to be constructed by or for the use of any Federal agency in the Continental U.S., Alaska, or Hawaii that is not legally subject to state or local building codes or similar requirements.

(h) "Life cycle cost" means the minimum life cycle cost calculated by using the methodology specified in Subpart A of 10 CFR Part 436.

(i) "Point system" means the tables that display the effect of the set of energy conservation options on the design energy consumption and energy costs of a residential building for a particular location, building type and fuel type.

(j) "Practicable optimum life cycle energy cost" means the energy costs of the set of conservation options that has the minimum life cycle cost to the Federal government incurred during a 25 year period and including the costs of construction, maintenance, operation, and replacement.

(k) "Project" means the group of one or more Federal residential buildings to be built at a specific geographic location that are included by a Federal agency in specifications issued or used by a Federal agency for design or construction of the buildings.

(l) "Residential building" means a new building that is designed to be constructed and developed for residential occupancy.

(m) "Set of conservation options" means the combination of envelope design and equipment options that influences the long term energy use in a building designed to maintain a minimum ventilation level of 0.7 air changes per hour, including the heating and cooling equipment, domestic hot water equipment, glazing, insulation, refrigerators and air infiltration control measures.

§ 435.303 Requirements for the design of a Federal residential building.

(a) The head of each Federal agency responsible for the construction of Federal residential buildings shall establish an energy consumption goal for each building to be designed or constructed by or for the agency.

(b) The energy consumption goal for a Federal residential building shall be a total point score derived by using the micro-computer program and user manual entitled "Conservation Optimization Standard for Savings in Federal Residences (COSTSAFR)," unless the head of the Federal agency shall establish more stringent requirements for that agency.

(c) The head of each Federal agency shall adopt such procedures as may be necessary to ensure that the design of a Federal residential building is not less energy conserving than the energy consumption goal established for the building.

§ 435.304 The COSTSAFR Program.

(a) The COSTSAFR Program (Version 2.0) provides a computerized calculation procedure to determine the most effective set of energy conservation measures, selected from among the measures included within the Program that will produce the practicable optimum life cycle cost for a type of residential building in a specific geographic location. The most effective set of energy conservation measures is expressed as a total point score that serves as the energy consumption goal.

(b) The COSTSAFR Program (Version 2.0) also prints out a point system that identifies a wide array of different energy conservation measures indicating how many points various levels of each measure would contribute to reaching the total point score of the energy consumption goal. This enables a Federal agency to use the energy consumption goal and the point system in the design and procurement procedures so that designers and builders can pick and choose among different combinations of energy conservation measures to meet or exceed the total point score required to meet the energy consumption goal.

(c) The COSTSAFR Program (Version 2.0) operates on a micro-computer system that uses the MS DOS operating system and is equipped with an 8087 co-processor.

(d) The COSTSAFR Program (Version 2.0) may be obtained from:

National Technical Information Service; Department of Commerce; Springfield, Virginia 22161; (202) 487-4600

PART 436—FEDERAL ENERGY MANAGEMENT AND PLANNING PROGRAMS

Sec.
436.1 Scope.
436.2 General objectives.

Subpart A—Methodology and Procedures for Life Cycle Cost Analyses

436.10 Purpose.
436.11 Definitions.
436.12 Life cycle cost methodology.
436.13 Presuming cost-effectiveness results.
436.14 Methodological assumptions.
436.15 Formatting cost data.
436.16 Establishing non-fuel cost data.
436.17 Establishing energy cost data.
436.18 Measuring cost-effectiveness.
436.19 Life cycle costs.
436.20 Net savings.
436.21 Savings-to-investment ratio.
436.22 Adjusted internal rate of return.
436.23 Estimated simple payback time.
436.24 Uncertainty analysis.

Subparts B—E [Reserved]

Subpart F—Guidelines for General Operations Plans

436.100 Purpose and scope.
436.101 Definitions.
436.102 General operations plan format and content.
436.103 Program goal setting.
436.104 Energy conservation measures and standards.
436.105 Emergency conservation plan.
436.106 Reporting requirements.
436.107 Review of plan.
436.108 Waivers.

APPENDIX A TO PART 436—ENERGY CONSERVATION STANDARDS FOR GENERAL OPERATIONS [RESERVED]
APPENDIX B TO PART 436—GOAL SETTING METHODOLOGY
APPENDIX C TO PART 436—GENERAL OPERATIONS ENERGY CONSERVATION MEASURES
APPENDIX D TO PART 436—ENERGY PROGRAM CONSERVATION ELEMENTS

AUTHORITY: Energy Policy and Conservation Act, as amended, 42 U.S.C. 6361; Executive Order 11912, as amended, 42 FR 37523 (July 20, 1977); National Energy Conservation Policy Act, Title V, Part 3, as amended. 42 U.S.C. 8251-8261.

SOURCE: 44 FR 60669, Oct. 19, 1979, unless otherwise noted.

§ 436.1 Scope.

This part sets forth the rules for Federal energy management and planning programs to reduce Federal energy consumption and to promote life cycle cost effective investments in building energy systems and energy conservation measures for Federal building.

[55 FR 48220, Nov. 20, 1990]

§ 436.2 General objectives.

The objectives of Federal energy management and planning programs are:

(a) To apply energy conservation measures to, and improve the design for construction of Federal buildings such that the energy consumption per gross square foot of Federal buildings in use during the fiscal year 1995 is at least 10 percent less than the energy consumption per gross square foot in 1985;

(b) To promote the methodology and procedures for conducting life cycle cost analyses of proposed investments in building energy systems and energy conservation measures; and

(c) To promote efficient use of energy in all agency operations through general operations plans.

[55 FR 48220, Nov. 20, 1990]

Subpart A—Methodology and Procedures for Life Cycle Cost Analyses

SOURCE: 55 FR 48220, Nov. 20, 1990, unless otherwise noted.

§ 436.10 Purpose.

This subpart establishes a methodology and procedures for estimating and comparing the life cycle costs of Federal buildings, for determining the life cycle cost effectiveness of energy conservation measures, and for rank ordering life cycle cost effective energy conservation measures in order to design a new Federal building or to retrofit an existing Federal building.

§ 436.11 Definitions.

As used in this subpart—

Base Year means the fiscal year in which a life cycle cost analysis is conducted.

Building energy system means an energy conservation measure or any portion of the structure of a building or any mechanical, electrical, or other functional system supporting the building, the nature or selection of which for a new building influences significantly the cost of energy consumed.

Component price means any variable sub-element of the total charge for a fuel or energy, including but not limited to such charges as "demand charges," "off-peak charges" and "seasonal charges."

Demand charge means that portion of the charge for electric service based upon the plant and equipment costs associated with supplying the electricity consumed.

DOE means Department of Energy.

Energy conservation measures means measures that are applied to an existing Federal building that improve energy efficiency and are life cycle cost effective and that involve energy conservation, cogeneration facilities, renewable energy sources, improvements in operation and maintenance efficiencies, or retrofit activities.

Federal agency means "agency" as defined by 5 U.S.C. 551(1).

Federal building means an energy conservation measure or any building, structure, or facility, or part thereof, including the associated energy consuming support systems, which is constructed, renovated, leased, or purchased in whole or in part for use by the Federal Government and which consumes energy. Such term also means a collection of such buildings, structures, or facilities and the energy consuming support systems for such collection.

Investment costs means the initial costs of design, engineering, purchase, construction, and installation exclusive of sunk costs.

Life Cycle Cost means the total cost of owning, operating and maintaining a building over its useful life (including its fuel, energy, labor, and replacement components), determined on the basis of a systematic evaluation and comparison of alternative building systems, except that in the case of leased buildings, the life cycle cost shall be calculated over the effective remaining term of the lease.

Non-recurring costs means costs that are not uniformly incurred annually over the study period.

Non-fuel operation and maintenance costs means material and labor cost for routine upkeep, repair and operation exclusive of energy cost.

Recurring costs means future costs that are incurred uniformly and annually over the study period.

Replacement costs means future cost to replace a building energy system, energy conservation measure, or any component thereof.

Retrofit means installation of a building energy system alternative in an existing Federal building.

Salvage value means the value of any building energy system removed or replaced during the study period, or recovered through resale or remaining at the end of the study period.

Study period means the time period covered by a life cycle cost analysis.

Sunk costs means costs incurred prior to the time at which the life cycle cost analysis occurs.

Time-of-day rate means the charge for service during periods of the day based on the cost of supplying services during various times of the day.

§ 436.12 Life cycle cost methodology.

The life cycle cost methodology for this part is a systematic analysis of relevant costs, excluding sunk costs, over a study period, relating initial costs to future costs by the technique of discounting future costs to present values.

§ 436.13 Presuming cost-effectiveness results.

(a) If the investment and other costs for an energy conservation measure considered for retrofit to an existing Federal building or a building energy system considered for incorporation into a new building design are insignificant, a Federal agency may presume that such a system is life cycle cost-effective without further analysis.

(b) A Federal agency may presume that an investment in an energy conservation measure retrofit to an existing Federal building is not life cycle cost-effective if the Federal building is—

(1) Occupied under a short-term lease with a remaining term of one year or less, and without a renewal option or with a renewal option which is not likely to be exercised;

(2) Occupied under a lease which includes the cost of utilities in the rent and does not provide a pass through of energy savings to the government; or

(3) Scheduled to be demolished or retired from service within one year or less.

§ 436.14 Methodological assumptions.

(a) Each Federal Agency shall discount to present values the future cash flows established in either current or constant dollars consistent with the nominal or real discount rate, and related tables, published in the annual supplement to the Life Cycle Costing Manual for the Federal Energy Management Program (NIST 85-3273) and determined annually by DOE as follows—

(1) The nominal discount rate shall be a 12 month average of the composite yields of all outstanding U.S. Treasury bonds neither due nor callable in less than ten years, as most recently reported by the Federal Reserve Board; and

(2) Subject to a ceiling of 10 percent and a floor of three percent the real discount rate shall be a 12 month average of the composite yields of all outstanding U.S. Treasury bonds neither due nor callable in less than ten years, as most recently reported by the Federal Reserve Board, adjusted to exclude estimated increases in the general level of prices consistent with projections of inflation in the most recent Economic Report of the President's Council of Economic Advisors.

(b) Each Federal agency shall assume that energy prices will change at rates projected by DOE's Energy

Information Administration and published by NIST annually no later than the beginning of the fiscal year in the Annual Supplement to the Life Cycle Costing Manual for the Federal Energy Management Program, in tables consistent with the discount rate determined by DOE under paragraph (a) of this section, except that—

(1) If the Federal agency is using component prices under § 436.14(c), that agency may use corresponding component escalation rates provided by the energy supplier.

(2) For Federal buildings in foreign countries, the Federal agency may use a "reasonable" escalation rate.

(c) Each Federal agency shall assume that the price of energy in the base year is the actual price charged for energy delivered to the Federal building and may use actual component prices as provided by the energy supplier.

(d) Each Federal agency shall assume that the appropriate study period is as follows:

(1) For evaluating and ranking alternative retrofits for an existing Federal building, the study period is the expected life of the retrofit, or 25 years from the beginning of beneficial use, whichever is shorter.

(2) For determining the life cycle costs or net savings of mutually exclusive alternatives for a given building energy system (e.g., alternative designs for a particular system or size of a new or retrofit building energy system), a uniform study period for all alternatives shall be assumed which is equal to—

(i) The estimated life of the mutually exclusive alternative having the longest life, not to exceed 25 years from the beginning of beneficial use with appropriate replacement and salvage values for each of the other alternatives; or

(ii) The lowest common multiple of the expected lives of the alternative, not to exceed 25 from the beginning of beneficial use with appropriate replacement and salvage values for each alternative.

(3) For evaluating alternative designs for a new Federal building, the study period extends from the base year through the expected life of the building or 25 years from the beginning of beneficial use, whichever is shorter.

(e) Each Federal agency shall assume that the expected life of any building energy system is the period of service without major renewal or overhaul, as estimated by a qualified engineer or architect, as appropriate, or any other reliable source except that the period of service of a building energy system shall not be deemed to exceed the expected life of the owned building, or the effective remaining term of the leased building (taking into account renewal options likely to be exercised).

(f) Each Federal agency may assume that investment costs are a lump sum occurring at the beginning of the base year, or may discount future investment costs to present value using the appropriate present worth factors under paragraph (a) of this section.

(g) Each Federal agency may assume that energy costs and non-fuel operation and maintenance costs begin to accrue at the beginning of the base year or when actually projected to occur.

(h) Each Federal agency may assume that costs occur in a lump sum at any time within the year in which they are incurred.

(i) This section shall not apply to calculations of estimated simple payback time under § 436.22 of this part.

§ 436.15 Formating cost data.

In establishing cost data under §§ 436.16 and 436.17 and measuring cost effectiveness by the modes of analysis described by § 436.19 through § 436.22, a format for accomplishing the analysis which includes all required input data and assumptions shall be used. Subject to § 436.18(b), Federal agencies are encouraged to use worksheets or computer software referenced in the Life Cycle Cost Manual for the Federal Energy Management Program.

§ 436.16 Establishing non-fuel cost categories.

(a) The relevant non-fuel cost categories are—

(1) Investment costs;

(2) Non-fuel operation and maintenance cost;

(3) Replacement cost; and

(4) Salvage value.

(b) The present value of recurring costs is the product of the base year value of recurring costs as multiplied by the appropriate uniform present worth factor under § 436.14, or as calculated by computer software indicated in § 436.18(b) and used with the official discount rate and escalation rate assumptions under § 436.14. When recurring costs begin to accrue at a later time, subtract the present value of recurring costs over the delay, calculated using the appropriate uniform present worth factor for the period of the delay, from the present value of recurring costs over the study period or, if using computer software, indicate a delayed beneficial occupancy date.

(c) The present value of non-recurring cost under § 436.16(a) is the product of the non-recurring costs as multiplied by appropriate single present worth factors under § 436.14 for the respective years in which the costs are expected to be incurred, or as calculated by computer software provided or approved by DOE and used with the official discount rate and escalation rate assumptions under § 436.14.

§ 436.17 Establishing energy cost data.

(a) Each Federal agency shall establish energy costs in the base year by multiplying the total units of energy used in the base year by the price per unit of energy in the base year as determined in accordance with § 436.14(c).

(b) When energy costs begin to accrue in the base year, the present value of energy costs over the study period is the product of energy costs in the base year as established under § 436.17(a), multiplied by the appropriate modified uniform present worth factor adjusted for energy price escalation for the applicable region, sector, fuel type, and study period consistent with § 436.14, or as calculated by computer software provided or approved by DOE and used with the official discount rate and escalation rate assumptions under § 436.14. When energy costs begin to accrue at a later time, subtract the present value of energy costs over the delay, calculated using the adjusted, modified uniform present worth factor for the period of delay, from the present value of energy costs over the study period or, if using computer software, indicate a delayed beneficial occupancy date.

§ 436.18 Measuring cost-effectiveness.

(a) In accordance with this section, each Federal agency shall measure cost-effectiveness by combining cost data established under §§ 436.16 and 436.17 in the appropriate mode of analysis as described in § 436.19 through § 436.22.

(b) Federal agencies performing LCC analysis on computers shall use either the Federal Buildings Life Cycle Costing (FBLCC) software provided by DOE or software consistent with this subpart.

(c) Replacement of a building energy system with an energy conservation measure by retrofit to an existing Federal building or by substitution in the design for a new Federal building shall be deemed cost-effective if—

(1) Life cycle costs, as described by § 436.19, are estimated to be lower; or

(2) Net savings, as described by § 436.20, are estimated to be positive; or

(3) The savings-to-investment ratio, as described by § 436.21, is estimated to be greater than one; or

(4) The adjusted internal rate of return, as described by § 436.22, is estimated to be greater than the discount rate as set by DOE.

(d) As a rough measure, each Federal agency may determine estimated simple payback time under § 436.23, which indicates whether a retrofit is likely to be cost-effective under one of the four calculation methods referenced in § 436.18(c). An energy conservation measure alternative is likely to be cost-effective if estimated payback time is significantly less than the useful life of that system, and of the Federal building in which it is to be installed.

(e) Mutually exclusive alternatives for a given building energy system, considered in determining such matters as the optimal size of a solar energy system, the optimal thickness of insulation, or the best choice of double-glazing or triple-glazing for windows, shall be compared and evaluated on the basis of life cycle costs or net savings over equivalent study periods. The alternative which is estimated to result in the lowest life cycle costs or the highest net savings shall be deemed the most cost-effective because it tends to minimize the life cycle cost of Federal building.

(f) When available appropriations will not permit all cost-effective energy conservation measures to be undertaken, they shall be ranked in descending order of their savings-to-investment ratios, or their adjusted internal rate of return, to establish priority. If available appropriations cannot be fully exhausted for a fiscal year by taking all budgeted energy conservation measures according to their rank, the set of energy conservation measures that will maximize net savings for available appropriations should be selected.

(g) Alternative building designs for new Federal buildings shall be evaluated on the basis of life cycle costs. The alternative design which results in the lowest life cycle costs for a given new building shall be deemed the most cost-effective.

§ 436.19 Life cycle costs.

Life cycle costs are the sum of the present values of—

(a) Investment costs, less salvage values at the end of the study period;

(b) Non-fuel operation and maintenance costs;

(c) Replacement costs less salvage costs of replaced building systems; and

(d) Energy costs.

§ 436.20 Net savings.

For a retrofit project, net savings may be found by subtracting life cycle costs based on the proposed project from life cycle costs based on not having it. For a new building design, net savings is the difference between the life cycle costs of an alternative design and the life cycle costs of the basic design.

§ 436.21 Savings-to-investment ratio.

The savings-to-investment ratio is the ratio of the present value savings to the present value costs of an energy conservation measure. The numerator of the ratio is the present value of net savings in energy and non-fuel operation and maintenance costs attributable to the proposed energy conservation measure. The denominator of the ratio is the present value of the net increase in investment and replacement costs less salvage value attributable to the proposed energy conservation measure.

§ 436.22 Adjusted internal rate of return.

The adjusted internal rate of return is the overall rate of return on an energy conservation measure. It is calculated by subtracting 1 from the Nth root of the ratio of the terminal value of savings to the present value of costs, where N is the number of years in the study period. The numerator of the ratio is calculated by using the discount rate to compound forward to the end of the study period the yearly net savings in energy and non-fuel operation and maintenance costs attributable to the proposed energy conservation measure. The denominator of the ratio is the present value of the net increase in investment and replacement costs less salvage value attributable to the proposed energy conservation measure.

§ 436.23 Estimated simple payback time.

The estimated simple payback time is the number of years required for the cumulative value of energy cost savings less future non-fuel costs to equal the investment costs of the building energy system, without consideration of future price changes or discount rates.

§ 436.24 Uncertainty analyses.

If particular items of cost data or timing of cash flows are uncertain and are not fixed under § 436.14, Federal agencies may examine the impact of uncertainty on the calculation of life cycle cost effectiveness or the assignment of rank order by conducting additional analyses using any standard engineering economics method such as sensitivity and probabilistic analysis. If additional analysis casts substantial doubt on the life cycle cost analysis results, a Federal agency should consider obtaining more reliable data or eliminating the building energy system alternative.

Subparts B—E [Reserved]

Subpart F—Guidelines for General Operations Plans

AUTHORITY: Energy Policy and Conservation Act, as amended, 42 U.S.C. 6361; Executive Order 11912, as amended, 42 FR 37523 (July 20, 1977); National Energy Conservation Policy Act, Title V, Part 3, 42 U.S.C. 8251 *et seq.*; Department of Energy Organization Act, 42 U.S.C. 7254.

SOURCE: 45 FR 44561, July 1, 1980, unless otherwise noted.

§ 436.100 Purpose and scope.

(a) *Purpose.* The purpose of this subpart is to provide guidelines for use by Federal agencies in their development of overall 10-year energy management plans to establish energy conservation goals, to reduce the rate of energy consumption, to promote the efficient use of energy, to promote switching for petroleum-based fuels and natural gas to coal and other energy sources, to provide a methodology for reporting their progress in meeting the goals of those plans, and to promote emergency energy conservation planning to assuage the impact of a sudden disruption in the supply of oil-based fuels, natural gas or electricity. The plan is intended to provide the cornerstone for a program to conserve energy in the general operations of an agency.

(b) *Scope.* This subpart applies to all general operations of Federal agencies and is applicable to management of all energy used by Federal agencies that is excluded from coverage pursuant to section 543(a)(2) of part 3 of title V of the National Energy Conservation Policy Act, as amended (42 U.S.C. 8251-8261).

[45 FR 44561, July 1, 1980, as amended at 55 FR 48223, Nov. 20, 1990]

§ 436.101 Definitions.

As used in this subpart—

"Automotive gasoline" means all grades of gasoline for use in internal combustion engines except aviation gasoline. Does not include diesel fuel.

"Aviation gasoline (AVGAS)" means all special grades of gasoline for use in aviation reciprocating engines.

"Btu" means British thermal unit; the quantity of heat required to raise the temperature of one pound of water one degree Fahrenheit.

"Cogeneration" means the utilization of surplus energy, e.g., steam, heat or hot water produced as a byproduct of the manufacture of some other form of energy, such as electricity. Thus, diesel generators are converted to cogeneration sets when they are equipped with boilers that make steam and hot water (usable as energy) from the heat of the exhaust and the water that cools the generator.

"Diesel and petroleum distillate fuels" means the lighter fuel oils distilled-off during the refining process. Included are heating oils, fuels, and fuel oil. The major uses of distillate fuel oils include heating, fuel for on- and off-highway diesel engines, marine diesel engines and railroad diesel fuel.

"DOE" means the Department of Energy.

"Emergency conservation plan" means a set of instructions designed to specify actions to be taken in response to a serious interruption of energy supply.

"Energy efficiency goal" means the ratio of production achieved to energy used.

"Energy use avoidance" means the amount of energy resources, e.g., gasoline, not used because of initiatives related to conservation. It is the difference between the baseline without a plan and actual consumption.

"Facility" means any structure or group of closely located structures, comprising a manufacturing plant, laboratory, office or service center, plus equipment.

"Federal agency" means any Executive agency under 5 U.S.C. 105 and the United States Postal Service, each entity specified in 5 U.S.C. 5721(1) (B) through (H) and, except that for purposes of this subpart, the Department of Defense shall be separated into four reporting organizations: the Departments of the Army, Navy and Air Force and the collective DOD agencies, with each responsible for complying with the requirements of this subpart.

"Fiscal year or FY" means, for a given year, October 1 of the prior year through September 30 of the given year.

"Fuel types" means purchased electricity, fuel oil, natural gas, liquefied petroleum gas, coal, purchased steam, automotive gasoline, diesel and petroleum distillate fuels, aviation gasoline, jet fuel, Navy special, and other identified fuels.

"General operations" means worldwide Federal agency operations, other than building operations, and includes services; production and industrial activities; operation of aircraft, ships, and land vehicles; and operation of Government-owned, contractor-operated plants.

"General transportation" means the use of vehicles for over-the-road driving as opposed to vehicles designed for off-road conditions, and the use of aircraft and vessels. This category does not include special purpose vehicles such as combat aircraft, construction equipment or mail delivery vehicles.

"Goal" means a specific statement of an intended energy conservation result which will occur within a prescribed time period. The intended result must be time-phased and must reflect expected energy use assuming planned conservation programs are implemented.

"Guidelines" means a set of instructions designed to prescribe, direct and regulate a course of action.

"Industrial or production" means the operation of facilities including buildings and plants which normally use large amounts of capital equipment, e.g., GOCO plants, to produce goods (hardware).

"Jet fuel" means fuels for use, generally in aircraft turbine engines.

"Life cycle cost" means the total cost of acquiring, operating and maintaining equipment over its economic life, including its fuel costs, determined on the basis of a systematic evaluation and comparison of alternative investments in programs, as defined in Subpart A of this part.

"Liquefied petroleum gas" means propane, propylene-butanes, butylene, propane-butane mixtures, and isobutane that are produced at a refinery, a natural gas processing plant, or a field facility.

"Maintenance" means activities undertaken to assure that equipment and energy-using systems operate effectively and efficiently.

"Measures" means actions, procedures, devices or other means for effecting energy efficient changes in general operations which can be applied by Federal agencies.

"Measure of performance" means a scale against which the fulfillment of a requirement can be measured.

"Navy special" means a heavy fuel oil that is similar to ASTM grade No. 6 oil or Bunker C oil. It is used to power U.S. Navy ships.

"Non-renewable energy source" means fuel oil, natural gas, liquefied petroleum gas, synthetic fuels, and purchased steam or electricity, or other such energy sources.

"Operational training and readiness" means those activities which are necessary to establish or maintain an agency's capability to perform its primary mission. Included are major activities to provide essential personnel strengths, skills, equipment/supply inventory and equipment condition. General administrative and housekeeping activities are not included.

"Overall plan" means the comprehensive agency plan for conserving fuel and energy in all operations, to include both the Buildings Plan developed pursuant to Subpart C of this part and the General Operations Plan.

"Plan" means those actions which an agency envisions it must undertake to assure attainment of energy consumption and efficiency goals without an unacceptably adverse impact on primary missions.

"Program" means the organized set of activities and allocation of resources directed toward a common purpose, objective, or goal undertaken or proposed by an agency in order to carry out the responsibilities assigned to it.

"Renewable energy sources" means sunlight, wind, geothermal, biomass, solid wastes, or other such sources of energy.

"Secretary" means the Secretary of the Department of Energy.

"Services" means the provision of administrative assistance or something of benefit to the public.

"Specific Functional Category" means those Federal agency activities which consume energy, or which are directly linked to energy consuming activities and which fall into one of the following groups: Services, General Transportation, Industrial or Production, Operational Training and Readiness, and Others.

"Standard" means an energy conservation measure determined by DOE to be applicable to a particular agency or agencies. Once established as a standard, any variance or decision not to adopt the measure requires a waiver.

"Under Secretary" means the Under Secretary of the Department of Energy.

"Variance" means the difference between actual consumption and goal.

"656 Committee" means the Interagency Federal Energy Policy Committee, the group designated in Section 656 of the DOE Organization Act to provide general oversight for interdepartmental FEMP matters. It is chaired by the Under Secretary of DOE and includes the designated Assistant Secretaries or Assistant Administrator of the Department of Defense, Commerce, Housing and Urban Development, Transportation, Agriculture, Interior and the U.S. Postal Service and General Services Administration, along with similar level representatives of the National Aeronautics and Space Administration and the Veterans Administration.

§ 436.102 General operations plan format and content.

(a) Each Federal agency shall prepare and submit to the Under Secretary, DOE, within six months from the effective date of these guidelines, a general operations 10-year plan which shall consist of two parts, an executive summary and a text. Subsequent agency revisions to plans shall be included in each agency's annual report on progress which shall be forwarded to DOE by July 1 annually.

(b) The following information shall be included in each Federal agency general operations 10-year plan for the period of fiscal years 1980–1990:

(1) An Executive Summary which includes—

(i) A brief description of agency missions, and applicable functional categories pursuant to § 436.106(a)(2);

(ii) A Goals and Objectives Section which summarizes what energy savings or avoidance will be achieved during the plan period, and what actions will be taken to achieve those savings, and the costs and benefits of measures planned for reducing energy consumption, increasing energy efficiencies, and shifting to a more favorable fuel mix. Assumptions of environmental, safety and health effects of the goals should be included;

(iii) A chart depicting the agency organizational structure for energy management, showing energy management program organization for headquarters and for major subordinate elements of the agency;

(iv) A schedule for completion of requirements directed in this subpart, including phase-out of any procedures made obsolete by these guidelines; and

(v) Identification of any significant problem which may impede the agency from meeting its energy management goals.

(2) A Text which includes—

(i) A Goals and Objectives Section developed pursuant to § 436.103 describing agency conservation goals; these goals will be related to primary mission goals;

(ii) An Investment Section describing the agency planned investment program by fiscal year, pursuant to Appendix B of this subpart, all measures selected pursuant to § 436.104, and the estimated costs and benefits of the measures planned for reducing energy consumption and increasing energy efficiencies;

(iii) An Organization Section which includes: (A) Designation of the principal energy conservation officer, such as an Assistant Secretary or Assistant Administrator, who is responsible for supervising the preparation, updating and execution of the Plan, for planning and implementation of agency energy conservation programs, and for coordination with DOE with respect to energy matters; (B) designation of a middle-level staff member as a point of contact to interface with the DOE

Federal Programs Office at the staff level; and (C) designation of key staff members within the agency who are responsible for technical inputs to the plan or monitoring progress toward meeting the goals of the plan;

(iv) An Issues Section addressing problems, alternative courses of action for resolution, and agency recommendations that justify any decisions not to plan for or implement measures contained in Appendix C of this subpart, and identifying any special projects, programs, or administrative procedures which may be beneficial to other Federal agency energy management programs:

(v) An implementing Instructions Section which includes a summary of implementing instructions issued by agency headquarters, and attachments of appropriate documents such as:

(A) Specific tasking resulting from development of the Plan;

(B) Guidance for the development of emergency conservation plans;

(C) Task milestones;

(D) Listing of responsible sub-agencies and individuals at both agency headquarters and subordinate units;

(E) Reporting and administrative procedures for headquarters and subordinate organizations;

(F) Report schedules pursuant to § 436.106(c);

(G) Schedules for feedback in order to facilitate plan updating, to include reviews of emergency conservation plans developed pursuant to § 436.105;

(H) Schedules for preparing and submitting the annual report on energy management pursuant to § 436.106(a);

(I) Schedules of plan preparation and publication;

(J) Communication, implementation, and control measures such as inspections, audits, and others; and

(vi) An Emergency Conservation Plan Summary Section pursuant to the requirements of § 436.105(d).

(3) Appendices which are needed to discuss and evaluate any innovative energy conserving technologies or methods, not included in this Part, which the agency has identified for inclusion in its plan.

(c) Each plan must be approved and signed by the principal energy conservation officer designated pursuant to paragraph (b)(2) of this section.

§ 436.103 Program goal setting.

(a) In developing and revising plans for a projected 10-year plan each agency shall establish and maintain energy conservation goals in accordance with the requirements of this section.

(b) Agencies shall establish three types of conservation goals:

(1) Energy consumption goals, by fuel type by functional category (see Appendix B).

(2) Energy efficiency goals by fuel type by functional category (see Appendix B).

(3) Fuel switching goals for shifting energy use from oil and natural gas to other fuels in more plentiful supply from domestic sources (see Appendix B).

(c) General operations energy conservation goals shall be established by each Federal agency with the broad purpose of achieving reductions in total energy consumption and increased efficiency without serious mission degradation or unmitigated negative environmental impacts. Within the broad framework, each agency should seek first to reduce energy consumption per unit of output in each applicable functional category. In evaluating energy efficiency, each agency should select and use standards of measurement which are consistent throughout the planning period. Particular attention should be given to increased energy use efficiency in nonrenewable fuel consumption. The second focus of attention should be on initiatives which shift energy use from oil and natural gas to other fuels in more plentiful supply from domestic sources.

§ 436.104 Energy conservation measures and standards.

(a) Each agency shall consider for inclusion in its plan the measures identified in Appendix C of this subpart.

(b) The following questions should be considered in the evaluation of each measure:

(1) Does this measure provide an incentive or disincentive?

(2) What is the estimate of savings by fuel type?

(3) What are the direct and indirect impacts of this measure?

(4) Is this measure to be mandatory throughout the agency?

(5) If not mandatory, under what circumstances will it be implemented, and who will be responsible for determining specific applicability?

(6) Who will be the direct participants in the implementation of this measure?

(7) What incentives (if any) are to be provided for the participants?

(8) When will this measure be implemented?

(9) Will this measure be implemented in a single step or will it be phased in? If it will be phased in, over what period of time?

(10) Will performance of the measure be evaluated and reported?

(11) By what criterion will performance be determined?

(12) Who will prepare performance reports?

(13) What is the reporting chain?

(14) What is the reporting period?

(c) Each agency will take all necessary steps to implement the energy conservation standards for general operations listed in Appendix A (reserved).

§ 436.105 Emergency conservation plan.

(a) Each agency shall establish an emergency conservation plan, a summary of which shall be included in the general operations plan, for assuaging the impact of a sudden disruption in the supply of oil-based fuels, natural gas or electricity. Priorities for temporarily reducing missions, production, services, and other programmatic or functional activities shall be developed in accordance with paragraph (b) of this section. Planning for emergencies is to address both buildings and general operations. Provisions shall be made for testing emergency actions to ascertain that they are effective.

(b) Federal agencies shall prepare emergency conservation plans for 10 percent, fifteen percent, and 20 percent reduction compared to the previous fiscal year in gasoline, other oil-based fuels, natural gas, or electricity for periods of up to 12 months. In developing these plans, agencies shall consider the potential for emergency reductions in energy use in buildings and facilities which the agency owns, leases, or has under contract and by employees through increased use of car and van pooling, preferential parking for multipassenger vehicles, and greater use of mass transit. Agencies may formulate whatever additional scenarios they consider necessary to plan for various energy emergencies.

(c) In general, Federal agencies' priorities shall go to those activities which directly support the agencies' primary missions. Secondary mission activities which must be curtailed or deferred will be reported to DOE as mission impacts. The description of mission impacts shall include estimates of the associated resources and time required to mitigate the effects of the reduction in energy. Other factors or assumptions to be used in energy conservation emergency planning are as follows:

(1) Agencies will be given 15-30 days notice to implement any given plan.

(2) Substitution of fuels in plentiful supply for fuels in short supply is authorized, if the substitution can be completed within a 3-month period and the cost is within the approval authority of the executive branch.

(3) All costs and increases in manpower or other resources associated with activities or projects to assuage mission impacts will be clearly defined in respective agency plans. One-time costs will be identified separately.

(4) Confronting the emergency situation will be considered a priority effort and all projects and increases in operating budgets within the approval authority of the executive branch will be expeditiously considered and approved if justified.

(d) Summary plans for agency-wide emergency conservation management shall be provided to DOE pursuant to § 436.102(b)(2)(vi). Such summaries shall include:

(1) Agency-wide impacts of energy reductions as determined in accordance with paragraph (b) of this section.

(2) Actions to be taken agency-wide to alleviate the energy shortfalls as they occur.

(3) An assessment of agency services or production that may need to be curtailed or limited after corrective actions have been taken.

(4) A summation of control and feedback mechanisms for managing an energy emergency situation.

§ 436.106 Reporting requirements.

(a) By July 1 of each year each Federal agency shall submit an "Annual Report on Energy Management" based on fiscal year data to the Secretary of DOE. The general operations portion of this report will encompass all agency energy use not reported in the buildings portion and shall include:

(1) A summary evaluation of progress toward the achievement of energy consumption, energy efficiency, and fuel switching goals established by the agency in its plans;

(2) Energy consumption reported by functional categories. Reports must include General Transportation and one or more of the following functional categories: industrial or production, services, operational training and readiness, and other. Agencies may report in subcategories of their own choosing. The following information is to be reported for the usage of each fuel type in physical units for each selected functional category:

(i) Total energy consumption goal;

(ii) Total energy consumed;

(iii) Total energy use avoidance;

(iv) Variance between actual consumption and consumption goal;

(v) Cost saved;

(vi) Status of planned investments, and if different from the investment program upon which existing goals are based, the expected impact on meeting goals; and

(vii) Summary of any other benefits realized.

(3) The energy efficiencies as calculated in accordance with appendix B of this subpart, or by an equivalent method, for the appropriate functional categories identified in paragraph (a)(2) of this section. The following information is to be reported for the energy efficiency for each fuel type by functional category:

(i) Energy efficiency goal;

(ii) Efficiency for the reporting period;

(iii) Summary of any other benefits realized.

(4) A summary of fuel switching progress including:

(i) Description and cost of investments in fuel switching;

(ii) Avoidance in use of oil-based fuels and natural gas;

(iii) Increased use of solar, wood, gasohol and other renewable energy sources;

(iv) Increased use of coal and coal derivatives, and

(v) Use of all other alternative fuels.

(b) Each agency's annual report shall be developed in accordance with a format to be provided by DOE and will include agency revisions to 10-year plans.

(c) Agencies whose annual total energy consumption exceeds one hundred billion Btu's, shall, in addition to the annual report required under paragraph (a) of this section, submit quarterly reports of the energy usage information specified in paragraph (a)(2) of this section.

(d) Agencies who consume energy in operations in foreign countries will include data on foreign operations if foreign consumption is greater than 10% of that consumed by the agency in the United States, its territories and possessions. If an agency's estimated foreign consumption is less than 10% of its total domestic energy use, reporting of foreign consumption is optional. Reports should be annotated if foreign consumption is not included.

[45 FR 44561, July 1, 1980, as amended at 51 FR 4586, Feb. 6, 1986]

§ 436.107 Review of plan.

(a) Each plan or revision of a plan shall be submitted to DOE and DOE will evaluate the sufficiency of the plan in accordance with the requirements of this subpart. Written notification of the adequacy of the plan including a critique, will be made by DOE and sent to the agency submitting the plan or revision within 60 days of submission. Agencies shall be afforded an opportunity to modify and return the plan within an appropriate period of time for review by DOE.

(b) A general operations plan under the guidelines will be evaluated with respect to:

(1) Adequacy of information or plan content required to be included by § 436.102;

(2) Adequacy of goal setting methodology or baseline justification as stated in § 436.103;

(3) Adequacy of a well-justified investment program which considers all measures included in Appendix C of this subpart; and

(4) Other factors as appropriate.

(c) After reviewing agency plans or revisions of plans, the Under Secretary of DOE, may submit to the "656" Committee for its recommendation, major problem areas or common deficiencies.

(d) Status of the plan review, the Under Secretary's decisions, and "656" Committee recommendations, will be published as appropriate in the DOE annual report to the President, titled "Energy Management in the Federal Government."

§ 436.108 Waivers.

(a) Any Federal agency may submit a written request to the Under Secretary for a waiver from the procedures and requirements of this subpart. The request for a waiver must identify the specific requirements and procedures of this subpart from which a waiver is sought and provide a detailed explanation, including appropriate information or documentation, as to why a waiver should be granted.

(b) A request for a waiver under this section must be submitted at least 60 days prior to the due date for the required submission.

(c) A written response to a request for a waiver will be issued by the Under Secretary no later than 30 days from receipt of the request. Such a response will either (1) grant the request with any conditions determined to be necessary to further the purposes of this subpart, (2) deny the request based on a determination that the reasons given in the request for a waiver do not establish a need that takes precedence over the futherance of the purposes of this subpart, or (3) deny the request based on the failure to submit adequate information upon which to grant a waiver.

(d) A requested waiver may be submitted by the Under Secretary to the "656" Committee for its review and recommendation. The agency official that submitted the request may attend any scheduled meeting of the "656" Committee at which the request is planned to be discussed. The determination to approve or disapprove a request for a waiver shall be made by the Under Secretary.

(e) Status of the requests for a waiver, the Under Secretary's decisions, and "656" Committee recommendations, will be published, as appropriate, in the DOE annual report to the President, entitled "Energy Management in the Federal Government."

APPENDIX A TO PART 436—ENERGY CONSERVATION STANDARDS FOR GENERAL OPERATIONS [RESERVED]

APPENDIX B TO PART 436—GOAL SETTING METHODOLOGY

In establishing and updating agency goals for energy conservation, the following methodology or an equivalent method should be utilized:

(a) For overall energy consumption—

(1) An analysis shall be made to determine what factors have the most significant impact upon the amount of each fuel type used by the agency in performing functions in support of its overall mission. Consideration is to be given, but not limited to, the following factors: Number of people using energy; number of vehicles using gasoline; amounts of other equipment using energy; tempo of operations (one, two, or three shifts); the type of operations (degree of equipment or labor intensity); equipment fuel limitations; environmental conditions (tropical versus arctic, etc.); budget levels for fuel, operations, maintenance, and equipment acquisition; and phase-out schedule (of older equipment or plants which may be inefficient). After identifying these factors, a further analysis shall be made to identify any projected workload changes in the quality or quantity of these factors on a yearly basis up to 1990.

(2) Based upon the analysis in (a)(1) and an evaluation of available information on past energy usage, a baseline of energy use by fuel type by functional category shall be

established beginning with FY 1975. In addition to "General Transportation," other functional categories should be selected to enhance energy management. Total fuel use for a particular activity may be allocated to the functional category for which the preponderance of fuel is used. Figure B-1 is an example of one such baseline.

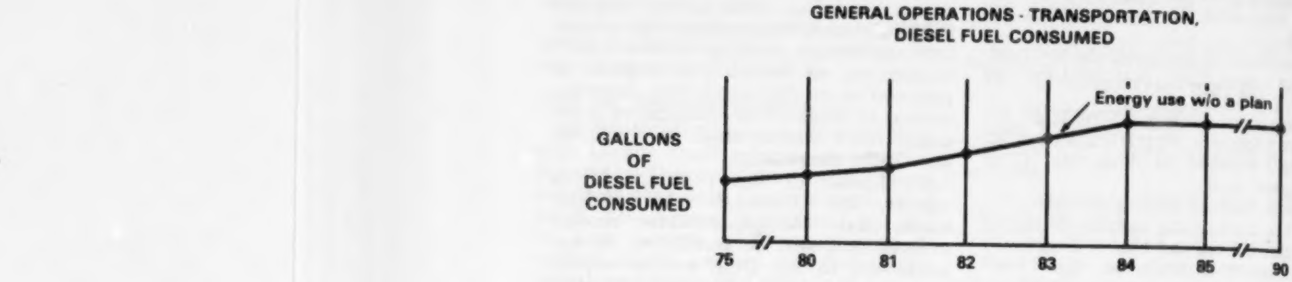


FIGURE B-1: GENERAL OPERATIONS · TRANSPORTATION, DIESEL FUEL CONSUMED

This example shows an increase in energy use, for a specific fuel type, during the period 1975-1981, with a further increase from 1981 to 1984 and a leveling off and no growth from 1984-1990. A justification, based on factors as discussed above, shall accompany each baseline.

(3) Thereafter, analyses should be made of the measures available for reducing the energy consumption profiles without adverse impact on mission accomplishment. Finding viable opportunities for reducing energy use, increasing energy efficiency and switching energy sources, will require consultation with specialists in the fields of operations, maintenance, engineering, design, and economics, and consideration of the measures identified in Appendix C. The DOE Federal Energy Management Programs Office can, upon request, provide information on where such resources can be located. Once these measures are identified, they are to be incorporated into a time-phased investment program, (using where appropriate, the life cycle costing factors and methodology in subpart A of this part). If investment and other costs for implementing a measure are insignificant, a Federal agency may presume that a measure is cost-effective without further analysis. An estimate must then be made as to the lead time required to implement the program and realize energy reductions.

Figure B-2 shows a summarized investment program, which should be accompanied by a detailed description of the measures, projects, and programs making up the total planned investments for each year. This summary need not be by function or fuel type.

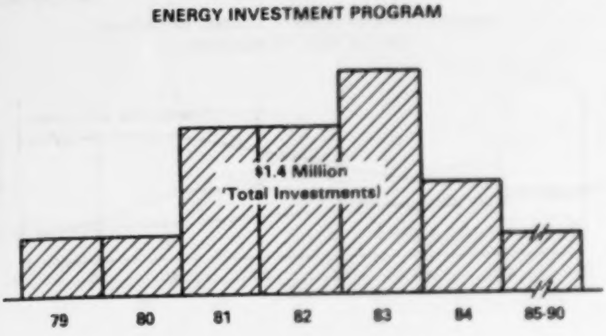


FIGURE B-2: ENERGY INVESTMENT PROGRAM

These analyses should enable the agency to project an energy consumption goal, with the assumption that funds for executing the planned projects will be approved. Figure B-3 shows a new energy use profile, with planned initiatives and related investments taken into consideration, and the resulting goal entitled "Energy Use With A Plan" superimposed on Figure B-1. Included are the anticipated effects on consumption cause by improvements in energy efficiency and fuel switching.

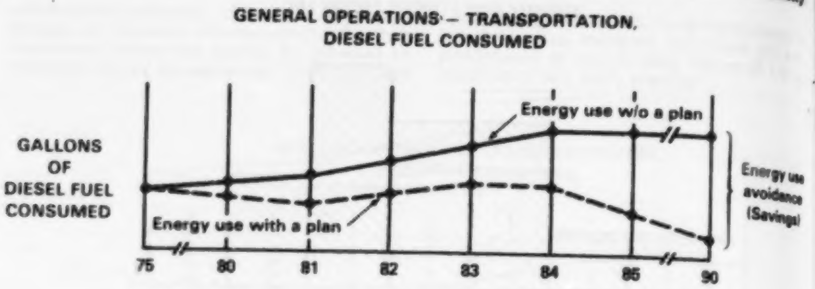


FIGURE B-3: GENERAL OPERATIONS – TRANSPORTATION, DIESEL FUEL CONSUMED

A comparison of these projections will show the energy use avoidance resulting from the investment program as depicted in Figure B-2. Using the prices of fuel contained in Appendix C to Subpart A, the dollars saved can be projected against the dollars invested. Life cycle costing methodology pursuant to subpart A, will be used to determine priorities for submitting individual initiatives into the appropriate budget year.

(b) For energy efficiencies—Energy efficiency baselines and goals for each fuel type shall be calculated using the same consumption factors and similar methodology to that outlined in paragraph (a). Energy consumption by fuel type shall be linked to mission through the functional categories listed in § 436.106(a)(2). This will identify a rate which will indicate energy efficiency trends. This linkage may be accomplished through the following algorithm:

Step 1: Determine functional categories from section 436.106(a)(2) which best describe the Agency overall mission.

Step 2: Determine types of fuels used to support the functions selected in Step 1.

Step 3: Determine quantities of fuel consumed or planned for consumption over a specific period of time.

Step 4: Determine quantity of output of function for same period of time used in Step 3. Quantify output in a standard measure which best describes functional category.

Step 5: Determine the energy efficiency ratio by dividing quantity from Step 4 by quantity from Step 3.

This ratio of fuel consumed to a unit measure of output will be used to develop a projection of a baseline and goals through 1990, and used in reporting variance. Examples of ratios that should be considered are:

- Production or industrial process type operations

Ton of product

Cu. ft. of natural gas

- Services, such as postal delivery

Customers served or
pounds delivered

Gallons of automotive
gasoline

- General transportation

Passenger miles

Gallons of automotive gasoline

- Training

Persons trained
or in training

Gallons of navy special

Agencies shall select one or more of these ratios, which shall be used throughout the planning period, or use more appropriate energy efficiency ratios, to describe their overall functions. Figure B-4 illustrates the planning baseline and goal resulting from this type of analysis.

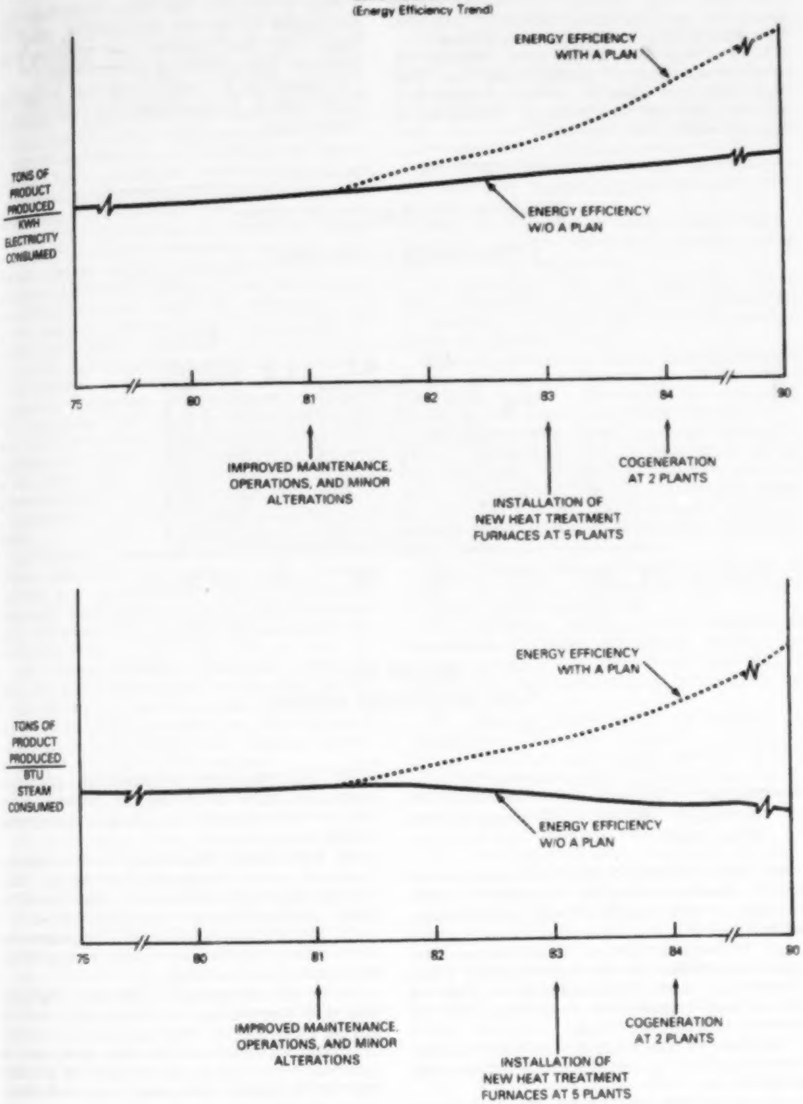


FIGURE B-4: GENERAL OPERATIONS, ELECTRICITY, STEAM CONSUMED.

(c) For fuel switching—Fuel switching goals for gasoline other oil-based fuel and natural gas may be calculated as follows:

Step 1: For each fiscal year, identify investments, where appropriate, in fuel switching from gasoline, other oil-based fuel and natural gas to alternate renewable or nonrenewable fuel sources.

Step 2: Project for each fiscal year, the avoidance in the use of gasoline, other oil-based fuel and natural gas resulting from previous fuel switching investments.

Completion of these steps will permit the formulation of charts such as that shown in Figure B-5.

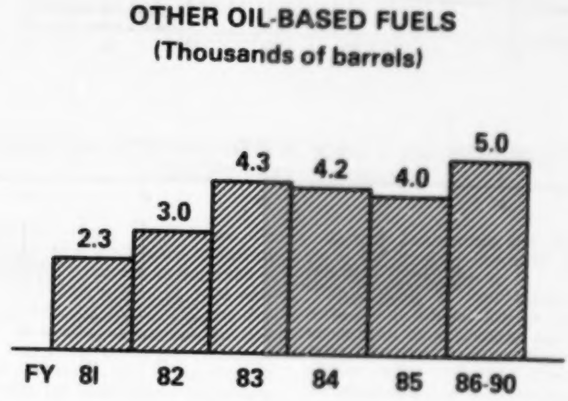


FIGURE B-5
FUEL SWITCHING GOALS

APPENDIX C TO PART 436—GENERAL OPERATIONS ENERGY CONSERVATION MEASURES

(a) The following individual measures or set of measures must be considered for inclusion in each agency 10-year energy management plan:

(1) Federal Employee Ridesharing Programs—Includes the use of vanpooling and carpooling and complies with existing orders and regulations governing parking for vanpools and carpools.

(2) Fleet Profile Change—Includes energy considerations in equipment selection and assignment.

(3) Fleet Mileage Efficiency—Includes agency plans to implement existing orders, goals, and laws related to vehicle fuel economy.

(4) Driver Training—Includes development of appropriate programs for training operators of U.S. Government vehicles in energy conservation.

(5) Maintenance Procedures Improvement—Includes activities to insure proper vehicle maintenance to optimize energy conservation.

(6) Operating Procedures Improvement—Includes use of cooperative passenger shuttle and courier services on an interagency or other basis within each metropolitan area.

(7) Mass Transit—Includes employee use of existing services for business-related activities and commuting.

(8) Public Education to Promote Vanpooling and Carpooling—Includes activities to support the EPCA requirement to establish "responsible public education programs to promote vanpooling and carpooling arrangements" through their employee awareness programs.

(9) Elimination of Free or Subsidized Employee Parking—Includes elimination of free or subsidized employee parking on Federal installations in accordance with OMB Cir. A-118, August 13, 1979.

(10) Two-Wheeled Vehicle Programs—Includes activities to encourage the substitu-

use of bicycles, mopeds, etc. for automobiles for commuting and operational purposes. These may include the establishment of weather-protected secure storage facilities, shower and locker facilities, and restricted routes for these vehicles on Federal property. Cooperative programs with local civil authorities may also be included.

(11) Consolidation of Facilities and Processes Activities—Includes such measures as physical consolidation of operations to minimize intra-operational travel and may include facility closure or conversion. Alternative work patterns, availability of transportation, energy source availability, and technical and financial feasibility are among the considerations that should be evaluated.

(12) Agency Procurement Programs—Includes activities to ensure that energy conservation opportunities are fully exploited with respect to the agency's procurement programs including procurements relating to operations and maintenance activities; e.g., (a) giving preference to fuel-efficient products whenever practicable, and (b) ensuring that agency's contractors having a preponderance of cost-type contracts pursue a comprehensive energy conservation program.

(13) Energy Conservation Awareness Programs—Includes programs aimed toward gaining and perpetuating employee awareness and participation in energy conservation measures on the job and in their personal activities.

(14) Communication—Includes substitution of communications for physical travel.

(15) Dress Code—Includes measures to allow employees greater freedom in their choice of wearing apparel to promote greater participation in conservation.

(16) Land Use—Includes energy considerations to be employed in new site selection, such as colocation.

(17) Automatic Data Processing (ADP)—Includes all energy aspects of ADP operation and equipment selection.

(18) Aircraft Operations—Includes energy-conserving measures developed for both military and Federal administrative and research and development aircraft operations.

(19) GOCO Facilities and Industrial Plants Operated by Federal Employees—Includes development of energy conservation plans at these facilities and plants which contain measures such as energy efficient periodic maintenance.

(20) Energy Conserving Capital Plant and Equipment Modification—Includes development of energy conservation and life cycle cost parameter measures for replacement of capital plant and equipment.

(21) Process Improvements—Includes measures to improve energy conservation in industrial process operations. These may include consideration of equipment replacement or modification, as well as scheduling and other operational changes.

(22) Improved Steam Maintenance and Management—Includes measures to improve energy efficiency of steam systems. These may include improved maintenance, installation of energy-conserving devices, and the operational use of substitutes for live steam where feasible.

(23) Improvements in Waste Heat Recovery—Includes measures utilizing waste heat for other purposes.

(24) Improvement in Boiler Operations—Includes energy-conserving retrofit measures for boiler operations.

(25) Improved Insulation—Includes measures addressing the addition or replacement of insulation on pipes, storage tanks, and in other appropriate areas.

(26) Scheduling by Major Electric Power Users—Includes measures to shift major electrical power demands to non-peak hours, to the maximum extent possible.

(27) Alternative Fuels—Includes measures to alter equipment such as generators to use lower quality fuels and to fill new requirements with those that use alternative fuels. The use of gasohol in stationary gasoline-powered equipment should be considered, in particular.

(28) Cogeneration—Includes measures to make full use of cogeneration in preference to single-power generation.

(29) Mobility Training and Operational Readiness—Includes measures which can reduce energy demands through the use of simulators, communications, computers for planning, etc.

(30) Energy Conservation Inspection or Instruction Teams—Includes measures which formulate and perpetuate the review of energy conservation through inspections to determine where specific improvements can be made and then followed by an instruction and training program.

(31) Intra-agency and Interagency Information Exchange Program—Includes measures providing a free exchange of energy conservation ideas and experiences between elements of an agency and between other agencies in the same geographic area.

(32) Recycled Waste—Includes measures to recycle waste materials such as paper products, glass, aluminum, concrete and brick, garbage, asphalt road materials or any material which requires a petroleum base.

(33) Fuel Conversion—Includes measures to accomplish conversion from petroleum based fuels and natural gas to coal and other alternative fuels for appropriate equipment.

(34) Operational Lighting—Includes measures to reduce energy consumption for lighting in operational areas and GOCO plants by: switching off by means of auto-

matic controls; maximizing the use of daylight by floor planning; keeping window and light fixtures clean and replacing fixtures when they begin to deteriorate, rather than when they fail altogether; providing automatic dimmer controls to reduce lighting when daylight increases; and cleaning the work area during daylight, if possible, rather than at night.

(35) Lighting Fixtures—Includes measures to increase energy efficiency of lighting. The following reveals the relative efficiencies of common lamp types.

Lamp type	Lumens watt	Improvement over tungsten
Tungsten lamp	12	X1
Modern fluorescent lamp	85	X7
Mercury halide lamp	100	X8
High pressure sodium lamp	110	X9
Low pressure sodium lamp	180	X15

(36) Industrial Buildings Heating—Includes measures to improve the energy conservation of industrial buildings such as: fixing holes in roofs, walls and windows; fitting flexible doors, fitting controls to heating systems; use of "economizer units" which circulate hot air back down from roof level to ground level; use of controlled ventilation; insulation of walls and roof; use of "optimisers" or optimum start controls in heating systems, so that the heating switch-on is dictated by actual temperature conditions rather than simply by time.

(37) Hull Cleaning and Antifouling Coating—Includes measures to reduce energy consumption through periodic cleaning of hulls and propellers or through the use of antifouling coatings.

(38) [Reserved]

(39) Building Temperature Restrictions on Thermostat Setting for Heating, Cooling and Hot Water—Includes enforcement of suggested restriction levels: 65 degrees for heating, 78 degrees for cooling, and 105 degrees or ban for hot water.

(40) Such other measures as DOE may from time-to-time add to this appendix, or as the Federal agency concerned may find to be energy-saving or efficient.

APPENDIX D TO PART 436—ENERGY PROGRAM CONSERVATION ELEMENTS

(a) In all successful energy conservation programs, certain key elements need to be present. The elements listed below must be incorporated into each agency conservation program and must be reflected in the 10-year plan prescribed in § 436.102. Those organizations that have already developed programs should review them to determine whether the present management systems incorporate these elements.

(1) *Top Management Control.* Top management must have a personal and sustained commitment to the program, provide active direction and motivation, and require regular review of overall energy usage at senior staff meetings.

(2) *Line Management Accountability.* Line managers must be accountable for the energy conservation performance of their organizations and should participate in establishing realistic goals and developing strategies and budgets to meet these goals.

(3) *Formal Planning.* An overall 10-year plan for the period 1980–1990 must be developed and formalized which sets forth performance-oriented conservation goals, including the categorized reduction in rates of energy consumption that the program is expected to realize. The plan will be supplemented by guidelines enumerating specific conservation procedures that will be followed. These procedures and initiatives must be life cycle cost-effective as well as energy efficient.

(4) *Goals.* Goals must be established in a measurable manner to answer questions of "Where are we?" "Where do we want to go?" "Are we getting there?" and "Are our initiatives for getting there life cycle cost-effective?"

(5) *Monitoring.* Progress must be reviewed periodically both at the agency headquarters and at local facility levels to identify program weakness or additional areas for conservation actions. Progress toward achievement of goals should be assessed, and explanations should be required for non-achievement or unusual variations in energy use. Monitoring should include personal inspections and staff visits, management information reporting and audits.

(6) *Using Technical Expertise.* Personnel with adequate technical background and knowledge of programmatic objectives should be used to help management set technical goals and parameters for efficient planning and implementation of energy conservation programs. These technicians should work in conjunction with the line managers who are accountable for both mission accomplishment and energy conservation.

(7) *Employee Awareness.* Employees must gain an awareness of energy conservation through formal training and employee information programs. They should be invited to participate in the process of developing an energy conservation program, and to submit definitive suggestions for conservation of energy.

(8) *Energy Emergency Planning.* Every energy management plan must provide for programs to respond to contingencies that may occur at the local, state or National

level. Programs must be developed for potential energy emergency situations calling for reductions of 10 percent, 15 percent and 20 percent for up to 12 months. Emergency plans must be tested to ascertain their effectiveness.

(9) *Budgetary and Fiscal Support.* Resources necessary for the energy conservation program must be planned and provided for, and the fiscal systems adjusted to support energy management investments and information reporting.

(10) *Environmental Considerations.* Each agency shall fulfill its obligations under the National Environmental Policy Act in developing its plan.

PART 440—WEATHERIZATION ASSISTANCE FOR LOW-INCOME PERSONS

Sec.

440.1 Purpose and scope.
440.2 Administration of grants.
440.3 Definitions.
440.10 Allocation of funds.
440.11 Native Americans.
440.12 State application.
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440.15 Subgrantees.
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440.17 Policy Advisory Council.
440.18 Allowable expenditures.
440.19 Labor.
440.20 Low-cost/no-cost weatherization activities.
440.21 Standards and techniques for weatherization.
440.22 Eligible dwelling units.
440.23 Oversight, training, and technical assistance.
440.24 Recordkeeping.
440.25 Reports.
440.26 Establishment of the Performance Fund.
440.27 Evaluating State Performance.
440.28 Awarding the Performance Fund.
440.29 Appeals.
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APPENDIX A—STANDARDS FOR WEATHERIZATION MATERIALS

AUTHORITY: Title IV, Energy Conservation and Production Act, Pub. L. 94-385, 90 Stat. 1150 (42 U.S.C. 6851 *et seq.*), as amended; Department of Energy Organization Act, Pub. L. 95-91, 91 Stat. 565 (42 U.S.C. 7101 *et seq.*).

SOURCE: 49 FR 3629, Jan. 27, 1984, unless otherwise noted.

§ 440.1 Purpose and scope.

This part contains the regulation adopted by the Department of Energy to carry out a program of weatherization assistance for low-income persons established by Part A of the Energy Conservation in Existing Buildings Act of 1976, 42 U.S.C. 6861 *et seq.*, enacted as Title IV of the Energy Conservation and Production Act, Pub. L. 94-385, 90 Stat. 1150 *et seq.*, and amended by Title II, Part 2 of the National Energy Conservation Policy Act, Pub. L. 95-619, 92 Stat. 3206 *et seq.*, and by the Energy Security Act, Pub. L. 96-294, 94 Stat. 611 *et seq.*

§ 440.2 Administration of grants.

Grant awards under this part shall comply with applicable law including, without limitation, the requirements of:

(a) Executive Order 12372 entitled "Intergovernmental Review of Federal Programs", 48 FR 3130, and the DOE Regulation implementing this Executive Order entitled "Intergovernmental Review of Department of Energy Programs and Activities" (10 CFR Part 1005);

(b) Office of Management and Budget Circular A-97, entitled "Rules and Regulations Permitting Federal Agencies to Provide Specialized or Technical Services to State and Local Units of Government under Title III of the Inter-Governmental Coordination Act of 1968;"

(c) Unless in conflict with provisions of this part, the DOE Financial Assistance Rule (10 CFR Part 600); and

(d) Such other procedures applicable to this part as DOE may from time to time prescribe for the administration of financial assistance.

§ 440.3 Definitions.

As used in this part:

Act means the Energy Conservation in Existing Buildings Act of 1976, as amended, 42 U.S.C. 6851 *et seq.*

Assistant Secretary means the Assistant Secretary for Conservation and Renewable Energy or official to whom the Assistant Secretary's functions may be redelegated by the Secretary.

CAA means a Community Action Agency.

Community Action Agency means a private corporation or public agency established pursuant to the Economic

Opportunity Act of 1964, Pub. L. 88-452, which is authorized to administer funds received from Federal, State, local, or private funding entities to assess, design, operate, finance, and oversee antipoverty programs.

Cooling Degree Days means a population-weighted annual average of the climatological cooling degree days for each weather station within a State, as determined by DOE.

Deputy Assistant Secretary means the Deputy Assistant Secretary for Technical and Financial Assistance or any official to whom the Deputy Assistant Secretary's functions may be redelegated by the Assistant Secretary.

DOE means the Department of Energy.

Dwelling Unit means a house, including a stationary mobile home, an apartment, a group of rooms, or a single room occupied as separate living quarters.

Elderly Person means a person who is 60 years of age or older.

Family Unit means all persons living together in a dwelling unit.

Governor means the chief executive officer of a State, including the Mayor of the District of Columbia.

Grantee means the State or other entity named in the Notification of Grant Award as the recipient.

Handicapped Person means any individual (1) who is a handicapped individual as defined in Section 7(6) of the Rehabilitation Act of 1973, (2) who is under a disability as defined in Section 1614(a)(3)(A) or 223(d)(1) of the Social Security Act or in Section 102(7) of the Developmental Disabilities Services and Facilities Construction Act, or (3) who is receiving benefits under Chapter 11 or 15 of Title 38, U.S.C.

Heating Degree Days means a population-weighted seasonal average of the climatological heating degree days for each weather station within a State, as determined by DOE.

Incidental Repairs means those repairs necessary for the effective performance or preservation of weatherization materials. Such repairs include, but are not limited to, framing or repairing windows and doors which could not otherwise be caulked or weather-stripped and providing protective materials, such as paint, used to seal materials installed under this program.

Indian Tribe means any tribe, band, nation, or other organized group or community of Native Americans, including any Alaskan native village, or regional or village corporation as defined in or established pursuant to the Alaska Native Claims Settlement Act, Pub. L. 92-203, 85 Stat. 688, which (1) is recognized as eligible for the special programs and services provided by the United States to Native Americans because of their status as Native Americans, or (2) is located on, or in proximity to, a Federal or State reservation or rancheria.

JTPA means the Job Training Partnership Act, 29 U.S.C. 1501 *et seq.*

Local Applicant means a CAA or other public or non profit entity unit of general purpose local government.

Low Income means that income in relation to family size which:

(1) Is at or below 125 percent of the poverty level determined in accordance with criteria established by the Director of the Office of Management and Budget, except that the Secretary may establish a higher level if the Secretary, after consulting with the Secretary of Agriculture and the Secretary of Health and Human Services, determines that such a higher level is necessary to carry out the purposes of this part and is consistent with the eligibility criteria established for the weatherization program under section 222(a)(12) of the Economic Opportunity Act of 1964;

(2) Is the basis on which cash assistance payments have been paid during the preceding twelve month-period under Titles IV and XVI of the Social Security Act or applicable State or local law; or

(3) If a State elects, is the basis for eligibility for assistance under the Low Income Home Energy Assistance Act of 1981, provided that such basis is at least 125 percent of the poverty level determined in accordance with criteria established by the Director of the Office of Management and Budget.

Native American means a person who is a member of an Indian tribe.

Number of Low-Income, Owner-Occupied Dwelling Units in the State means the number of such dwelling units in a State, as determined by DOE.

Number of Low-Income, Renter-Occupied Dwelling Units in the State means the number of such dwelling units in a State, as determined by DOE.

Operations Office Manager means the manager of a DOE Operations Office or the manager's designee, or any official to whom the manager's functions may be redelegated by the Secretary.

Percentage of Total Residential Energy Used for Space Cooling means the national percentage of total energy used for space cooling, as determined by DOE.

Percentage of Total Residential Energy Used for Space Heating means the national percentage of total energy used for space heating, as determined by DOE.

Relevant Reporting Period means the Federal fiscal year beginning on October 1 and running through September 30 of the following calendar year.

Rental Dwelling Unit means a dwelling unit occupied by a person who pays rent for the use of the dwelling unit.

Secretary means the Secretary of the Department of Energy.

Separate Living Quarters means living quarters in which the occupants do not live and eat with any other persons in the structure and which have either (1) direct access from the outside of the building or through a common hall or (2) complete kitchen facilities for the exclusive use of the occupants. The occupants may be a single family, one person living alone, two or more families living together, or any other group of related or unrelated persons who share living arrangements.

Single-Family Dwelling Unit means a structure containing no more than one dwelling unit.

Skirting means material used to border the bottom of a dwelling unit to prevent infiltration.

State means each of the States and the District of Columbia.

Subgrantee means an entity managing a weatherization project which receives a grant of funds awarded under this part from a grantee.

Tribal Organization means the recognized governing body of any Indian tribe or any legally established organization of Native Americans which is controlled, sanctioned, or chartered by such governing body.

Unit of General Purpose Local Government means any city, county, town, parish, village, or other general purpose political subdivision of a State.

Vestibule' means an enclosure built around a primary entry to a dwelling unit.

Weatherization Materials mean:

(1) Caulking and weatherstripping of doors and windows;

(2) Furnace efficiency modifications, including, but not limited to—

(i) Replacement burners, furnaces, or boilers or any combination thereof;

(ii) Devices for minimizing energy loss through heating system, chimney, or venting devices; and

(iii) Electrical or mechanical furnace ignition systems which replace standing gas pilot lights.

(3) Clock thermostats;

(4) Ceiling, attic, wall, floor, and duct insulation;

(5) Water heater insulation;

(6) Storm windows and doors, multiglazed windows and doors, heat-absorbing or heat-reflective window and door materials; and

(7) The following insulating or energy conserving devices or technologies:

(i) Skirting;

(ii) Items to improve attic ventilation;

(iii) Vapor barriers;

(iv) Materials used as a patch to reduce infiltration through the building envelope;

(v) Water flow controllers;

(vi) Movable insulation systems for windows;

(vii) Materials to construct vestibules;

(viii) Pipe and boiler insulation;

(ix) Heat exchangers;

(x) Thermostat control systems;

(xi) Replacement windows and doors;

(xii) Materials used for water heater modifications which will result in improved energy efficiency;

(xiii) Hot water heat pumps;

(xiv) Waste heat recovery devices;

(xv) Materials used for heating and cooling system tuneups, repairs, and modifications which will result in improved energy efficiency; and

(xvi) Materials used for boiler tuneups, repairs, and modifications which will result in improved energy efficiency.

Weatherization Project means a project conducted in a single geographical area which undertakes to weatherize dwelling units that are energy inefficient.

[49 FR 3629, Jan. 27, 1984, as amended at 50 FR 712, Jan. 4, 1985; 50 FR 49917, Dec. 5, 1985; 55 FR 41325, Oct. 10, 1990]

§ 440.10 Allocation of funds.

(a) DOE shall allocate finanical assistance for each State from sums appropriated for any fiscal year, only upon annual application.

(b) DOE shall determine the tentative allocation for each State from available funds as follows:

(1) The first $5,100,000 appropriated shall be divided equally among the States; an additional $100,000 shall be allocated to Alaska.

(2) The percentage of the remaining available funds tentatively allocated to each State shall be determined by the following formula:

(i) The square of the number of heating degree days in a State multiplied by the percentage of total residential energy used for space heating;

(ii) Plus the square of the number of cooling degree days in the State multiplied by the percentage of total residential energy used for space cooling;

(iii) Multiplied by the sum of the number of low-income, owner-occupied dwelling units in the State and one-half of the number of low-income, renter-occupied dwelling units in the State;

(iv) Divided by the sum of the result produced for all States by the computation outlined in paragraphs (b)(2) (i), (ii) and (iii) of this section; and

(v) Multiplied by 100.

(c) DOE may reduce the tentative allocation for a State by the amount DOE determines cannot be reasonably expended by a grantee to weatherize dwelling units during the budget period for which financial assistance is to be awarded. In reaching this determination, DOE will consider the amount of unexpended financial assistance currently available to a grantee under this part and the number of dwelling units which remain to be weatherized with the unexpended financial assistance.

(d) DOE may increase the tentative allocation of a State by the amount DOE determines the grantee can expend to weatherize additional dwelling units during the budget period for which financial assistance is to be awarded.

(e) The Operations Office Manager shall notify each State of the tentative allocation for which that State is eligible to apply.

§ 440.11 Native Americans.

(a) Notwithstanding any other provision of this part, the Operations Office Manager may determine, after taking into account the amount of funds made available to a State to carry out the purposes of this part, that:

(1) The low-income members of an Indian tribe are not receiving benefits under this part equivalent to the assistance provided to other low-income persons in the State under this part and

(2) The low-income members of such tribe would be better served by means of a grant made directly to provide such assistance.

(b) In any State for which the Operations Office Manager shall have made the determination referred to in paragraph (a) of this section, the Operations Office Manager shall reserve from the sums that would otherwise be allocated to the State under this part not less than 100 percent, or more than 150 percent, of an amount which bears the same ratio to the State's allocation for the fiscal year involved as the population of all low-income Native Americans for whom a determination under paragraph (a) of this section has been made bears to the population of all low-income persons in the State.

(c) The Operations Office Manager shall make the determination prescribed in paragraph (a) of this section in the event a State:

(1) Does not apply within the sixty-day time period prescribed in § 440.12(a);

(2) Recommends that direct grants be made for low-income members of an Indian tribe as provided in § 440.12(b)(5);

(3) Files an application which DOE determines, in accordance with the procedures in § 440.30, not to make adequate provision for the low-income members of an Indian tribe residing in the State; or

(4) Has received grant funds and DOE determines, in accordance with the procedures in § 440.30, that the State has failed to implement the procedures required by § 440.16(6).

(d) Any sums reserved by the Operations Office Manager pursuant to paragraph (b) of this section shall be granted to the tribal organization serving the individuals for whom the determination has been made, or where there is no tribal organization, to such other entity as the Operations Office Manager determines is able to provide adequate weatherization assistance pursuant to this part. Where the Operations Office Manager intends to make a grant to an organization to perform services benefiting more than one Indian tribe, the approval of each Indian tribe shall be a prerequisite for the issuance of a notice of grant award.

(e) Within 30 days after the Operations Office Manager has reserved funds pursuant to paragraph (b) of this section, the Operations Office Manager shall give written notice to the tribal organization or other qualified entity of the amount of funds reserved and its eligibility to apply therefor.

(f) Such tribal organization or other qualified entity shall thereafter be treated as a unit of general purpose local government eligible to apply for funds hereunder, pursuant to the provisions of § 440.13.

§ 440.12 State application.

(a) To be eligible for financial assistance under this part, a State shall submit an application to DOE in conformity with the requirements of this part not later than 60 days after the date of notice to apply is received from the Operations Office Manager. After receipt of an application for financial assistance or for approval of an amendment to a State plan, the Operations Office Manager may request the State to submit within a reasonable period of time any revisions necessary to make the application complete or to bring the application into compliance with the requirements of this part. The Operations Office Manager shall attempt to resolve any dispute over the application informally and to seek voluntary compliance. If a State fails to submit timely appropriate revisions to complete the application, the Operations Office Manager may reject the application as incomplete in a written decision, including a statement of reasons, which shall be subject to administrative review under § 440.30 of this part.

(b) Each application shall include:

(1) The name and address of the State agency or office responsible for administering the program;

(2) A copy of the final State plan prepared after notice and a public hearing in accordance with § 440.14(a), except that an application by a local applicant need not include a copy of the final State plan;

(3) The budget for total funds applied for under the Act, which shall include a justification and explanation of any amounts requested for expenditure pursuant to § 440.18(d) for State administration;

(4) The total number of dwelling units proposed to be weatherized with grant funds during the budget period for which assistance is to be awarded, (i) with financial assistance previously obligated under this part, and (ii) with the tentative allocation to the State;

(5) A recommendation that a tribal organization be treated as a local applicant eligible to submit an application pursuant to § 440.13(b), if such a recommendation is to be made;

(6) A monitoring plan which shall indicate the method used by the State to insure the quality of work and adequate financial management control at the subgrantee level;

(7) A training and technical assistance plan which shall indicate how

funds for training and technical assistance will be used; and

(8) Any further information which the Secretary finds necessary to determine whether an application meets the requirements of this part.

(c) On or before 60 days from the date that a timely filed application is complete, the Operations Office Manager shall decide whether DOE shall approve the application. The Operations Office Manager may—

(1) Approve the application in whole or in part to the extent that the application conforms to the requirements of this part;

(2) Approve the application in whole or in part subject to special conditions designed to ensure compliance with the requirements of this part; or

(3) Disapprove the application if it does not conform to the requirements of this part.

(Approved by the Office of Management and Budget under control number 1904-0047)

[49 FR 3629, Jan. 27, 1984, as amended at 50 FR 712, Jan. 4, 1985; 55 FR 41325, Oct. 10, 1990]

§ 440.13 Local applications.

(a) The Operations Office Manager shall give written notice to all local applicants throughout a State of their eligibility to apply for financial assistance under this part in the event:

(1) A State, within which a local applicant is situated, fails to submit an application within 60 days after notice in accordance with § 440.12(a) or

(2) The Operations Office Manager finally disapproves the application of a State pursuant to § 440.30 of this part.

(b) To be eligible for financial assistance, a local applicant shall submit an application pursuant to § 440.12(b) to the Operations Office Manager within 30 days after receiving the notice referred to in paragraph (a) of this section.

(c) In the event one or more local applicants submit applications, the Operations Office Manager shall combine the hearing on the proposed plan pursuant to § 440.14(a) with a hearing on the intention to deny the timely application of one or more local applicants, as provided in § 440.30, to the maximum extent practicable. Based upon the final plan developed by the Operations Office Manager, the hearing, and information submitted by a local applicant and other interested persons, the Operations Office Manager shall determine whether or not to award a grant to a local applicant, and the amount thereof. The Operations Office Manager may provide financial assistance to a local applicant to carry out one or more weatherization projects.

(Approved by the Office of Management and Budget under control number 1904-0047)

§ 440.14 State plans.

(a) Before submitting an application, a State shall give not less than 10 days notice of hearing, reasonably calculated to inform prospective subgrantees, and shall conduct one or more public hearing for the purpose of receiving comments on a proposed State plan. The proposed State plan shall identify and describe proposed weatherization projects, including a statement of proposed subgrantees and the amount each will receive; shall address the other items contained in paragraph (b) of this section; and shall be made available throughout the State prior to the hearing. The notice for the hearing shall specify that copies of the plan are available and how they may be obtained. A transcript of the hearings shall be prepared and written submission of views and data shall be accepted for the record.

(b) Subsequent to the hearing, the State shall prepare a final State plan which shall identify and describe:

(1) The production schedule for the State which shall indicate projected expenditures and the number of dwelling units which are expected to be weatherized each month during the program year;

(2) An estimate of the number of dwelling units expected to be weatherized during the program year by category to include:

(i) Single family and multi family residences;

(ii) Elderly persons residences;

(iii) Handicapped persons residences;

(iv) Renters residences; and

(v) If Native Americans do not receive direct grants under § 440.11, Native American residences.

(3) The climatic conditions within the State;

(4) The type of weatherization work to be done;

(5) An estimate of the amount of energy to be conserved;

(6) An estimate of the number of eligible dwelling units in which the elderly reside;

(7) An estimate of the number of eligible dwelling units in which the handicapped reside;

(8) Each area to be served by a weatherization project within the State, and shall include for each area:

(i) The tentative allocation;

(ii) The number of dwelling units expected to be weatherized during the program year;

(iii) The estimated number of rental dwelling units to be weatherized; and

(iv) Sources of labor.

(9) The manner in which the State plan is to be implemented, and shall include:

(i) An analysis of the existence and effectiveness of any weatherization project being carried out by a subgrantee;

(ii) An explanation of the method used to select each area to be served by a weatherization project;

(iii) The extent to which priority will be given to the weatherization of single-family or other high energy consuming dwelling units;

(iv) The amount of non-Federal resources to be applied to the program;

(v) The amount of Federal resources, other than DOE weatherization grant funds, to be applied to the program;

(vi) The amount of weatherization grant funds tentatively allocated to the State under this part;

(vii) The expected average cost per dwelling to be weatherized, taking into account the total number of dwellings to be weatherized and the total amount of funds, Federal and non-Federal, expected to be applied to the program;

(viii) The average amount of the DOE funds specified in § 440.18(c)(1)-(11) to be applied to any dwelling unit;

(ix) The average amount of DOE funds to be applied to any dwelling unit for weatherization materials as specified in § 440.18(c)(1);

(x) Procedures for determining the most cost-effective measures in a dwelling unit or a statement that Project Retro-Tech will be used; and

(xi) The definition of "low income" in accordance with § 440.3 which the State has chosen for determining eligibility.

(Approved by the Office of Management and Budget under control number 1904-0047)

[49 FR 3629, Jan. 27, 1984, as amended at 50 FR 712, Jan. 4, 1985]

§ 440.15 Subgrantees.

(a) The grantee shall ensure that:

(1) Each subgrantee is a CAA or other public or nonprofit entity;

(2) Each subgrantee is selected on the basis of public comment received during a public hearing conducted pursuant to § 440.14(a) and other appropriate findings regarding:

(i) The subgrantee's experience and performance in weatherization or housing renovation activities;

(ii) The subgrantee's experience in assisting low-income persons in the area to be served; and

(iii) The subgrantee's capacity to undertake a timely and effective weatherization program.

(3) In selecting a subgrantee, preference is given to any CAA or other public or nonprofit entity which has, or is currently administering, an effective program under this part or under Title II of the Economic Opportunity Act of 1964, with program effectiveness evaluated by consideration of factors including, but not necessarily limited to, the following:

(i) The extent to which the past or current program achieved or is achieving weatherization goals in a timely fashion;

(ii) The quality of work performed by the subgrantee;

(iii) The number, qualifications, and experience of the staff members of the subgrantee; and

(iv) The ability of the subgrantee to secure volunteers, training participants, and public service employment workers pursuant to JTPA.

(b) The grantee shall ensure that the funds received under this part will be allocated to the entities selected in accordance with paragraph (a) of this section, such that funds will be allocated to areas on the basis of the relative need for a weatherization project by low-income persons.

(c) If DOE finds that a subgrantee selected to undertake weatherization activities under this part has failed to comply substantially with the provisions of the Act or this part and should be replaced, such finding shall be treated as a finding under § 440.30(i) for purposes of § 440.30.

(d) Any new or additional subgrantee shall be selected at a hearing in accordance with § 440.14(a) and upon the basis of the criteria in paragraph (a) of this section.

[49 FR 3629, Jan. 27, 1984, as amended at 55 FR 41326, Oct. 10, 1990]

§ 440.16 Minimum program requirements.

Prior to the expenditure of any grant funds each grantee shall develop, publish, and implement procedures to ensure that:

(a) No dwelling unit may be weatherized without documentation that the dwelling unit is an eligible dwelling unit as provided in § 440.22;

(b) Priority is given to identifying and providing weatherization assistance to elderly and handicapped low-income persons, and such priority as the applicant determines is appropriate is given to single-family or other high-energy-consuming dwelling units;

(c) Financial assistance provided under this part will be used to supplement, and not supplant, State or local funds, and, to the maximum extent practicable as determined by DOE, to increase the amounts of these funds that would be made available in the absence of Federal funds provided under this part;

(d) To the maximum extent practicable, the grantee will secure the services of volunteers, training participants and public service employment workers, pursuant to JTPA, to work under the supervision of qualified supervisors and foremen;

(e) To the maximum extent practicable, the use of weatherization assistance shall be coordinated with other Federal, State, local, or privately funded programs in order to improve energy efficiency and to conserve energy;

(f) The low-income members of an Indian tribe shall receive benefits equivalent to the assistance provided to other low-income persons within a State unless the grantee has made the recommendation provided in § 440.12(b)(5); and

(g) No dwelling unit may be reported to DOE as completed until the subgrantee, or its authorized representative, has performed a final inspection and certified that applicable work has been completed in a workmanlike manner and in accordance with the priority determined by the audit procedures required by § 440.21(b).

(Approved by the Office of Management and Budget under control number 1904-0047)

§ 440.17 Policy Advisory Council.

(a) Prior to the expenditure of any grant funds, a State policy advisory council shall be established by a State or by the Operations Office Manager if a State does not participate in the program which:

(1) Has special qualifications and sensitivity with respect to solving the problems of low-income persons, including the weatherization and energy conservation problems of these persons;

(2) Is broadly representative of organizations and agencies, including consumer groups that represent low-income persons, particularly elderly and handicapped low-income persons and low-income Native Americans, in the State or geographical area in question; and

(3) Has responsibility for advising the appropriate official or agency administering the allocation of financial assistance in the State or area with respect to the development and implementation of a weatherization assistance program.

§ 440.18 Allowable expenditures.

(a) An average of at least forty percent of the funds provided in a State under this part for weatherization materials, labor and related matters included in paragraphs (c)(1) through (9) of this section shall be spent for weatherization materials.

(b) The expenditure of financial assistance provided under this part for labor, weatherization materials and related matters included in paragraphs (c)(1) through (9) of this section shall not exceed an average of $1,600 per dwelling unit weatherized in the State.

(c) Allowable expenditures under this part include only:

(1) The cost of purchase and delivery of weatherization materials;

(2) Labor costs, in accordance with § 440.19;

(3) Transportation of weatherization materials, tools, equipment, and work crews to a storage site and to the site of weatherization work;

(4) Maintenance, operation, and insurance of vehicles used to transport weatherization materials;

(5) Maintenance of tools and equipment;

(6) Purchase or annual lease of tools, equipment, and vehicles, except that any purchase of vehicles shall be referred to DOE for prior approval in every instance;

(7) Employment of on-site supervisory personnel;

(8) Storage of weatherization materials, tools and equipment;

(9) The cost of incidental repairs if such repairs are necessary to make the installation of weatherization materials effective;

(10) The cost of liability insurance for weatherization projects for personal injury and for property damage;

(11) The cost of carrying out low-cost/no-cost weatherization activities in accordance with § 440.20; and

(12) Allowable administrative expenses under paragraph (d) of this section.

(d) Not more than 10 percent of any grant made to a State may be used by the grantee and subgrantees for administrative purposes in carrying out duties under this part, except that not more than 5 percent may be used by the State for such purposes.

(e) No grant funds awarded under this part shall be used for any of the following purposes:

(1) To weatherize a dwelling unit which is designated for acquisition or clearance by a Federal, State, or local program within twelve months from the date weatherization of the dwelling unit would be scheduled to be completed; or

(2) To install or otherwise provide weatherization materials for a dwelling unit weatherized previously with grant funds under paragraph (a)(1) of this section, except:

(i) As provided under § 440.20;

(ii) Unless such dwelling unit has been damaged by fire, flood or act of God and repair of the damage to weatherization materials is not paid for by insurance; or

(iii) That dwelling units partially weatherized under this part or under other Federal programs during the period September 30, 1975, through September 30, 1979, may receive further financial assistance for weatherization under this part.

[50 FR 712, Jan. 4, 1985]

§ 440.19 Labor.

(a) Payments for labor costs under § 440.18(c)(2) shall consist of:

(1) Payments permitted by the Department of Labor to supplement wages paid to training participants and public service employment workers pursuant to JTPA and

(2) Payments to employ labor (particularly persons eligible for training under JTPA) or to engage a contractor (particularly a nonprofit organization or a business owned by disadvantaged individuals which performs weatherization services), to install weatherization materials provided a grantee has determined an adequate number of volunteers, training participants, and public service employment workers, assisted pursuant to JTPA, are not available to weatherize dwelling units for a subgrantee under the supervision of qualified supervisors.

[49 FR 3629, Jan. 27, 1984, as amended at 50 FR 713, Jan. 4, 1985]

§ 440.20 Low-cost/no-cost weatherization activities.

(a) An eligible dwelling unit may be weatherized without regard to the limitations contained in § 440.18 (e)(2) or § 440.21(b) from funds designated by the grantee for carrying out low-cost/

no-cost weatherization activities provided:

(1) Inexpensive weatherization materials are used, such as water flow controllers, furnace or cooling filters, or items which are primarily directed toward reducing infiltration, including weatherstripping, caulking, glass patching, and insulation for plugging and

(2) No labor paid with funds provided under this part is used to install weatherization materials referred to in paragraph (a)(1) of this section.

(b) A maximum of 10 percent of the amount allocated to a subgrantee, not to exceed $50 in materials costs per dwelling unit, may be expended to carry out low-cost/no-cost weatherization activities, unless the Operations Office Manager approves a higher expenditure per dwelling unit.

[49 FR 3629, Jan. 27, 1984, as amended at 50 FR 713, Jan. 4, 1985]

§ 440.21 Standards and techniques for weatherization.

(a) For those weatherization materials listed in § 440.3, only weatherization materials which meet or exceed standards prescribed in Appendix A to this part shall be purchased with funds provided under this part.

(b) The most cost-effective weatherization materials for each dwelling unit shall be determined by audit procedures using the following formula:

(1) The cost of fuel saved per year by installing a weatherization material in a dwelling unit;

(2) Multiplied by the appropriate lifetime of the weatherization material; and

(3) Divided by the cost of the weatherization material and the cost of the installation of the weatherization material.

(c) The computation of the cost of fuel saved per year must take into account the number of heating or cooling degree days in the area for which the computation is being made and must otherwise use reasonable methods and assumptions.

(d) The figures used for the lifetime of the materials and for the costs of materials and cost of the installation of the materials must be generally accepted in the relevant trade.

(e) The weatherization materials which shall be installed first are those which are determined to be the most cost effective using the formula in paragraph (b) of this section.

(f) The audit procedures used in Project Retro-Tech to determine the most cost-effective weatherization materials comply with this section. The grantee or subgrantee may use other audit procedures to determine the most cost-effective weatherization materials, provided that these procedures comply with this section and are approved by the Operations Office Manager prior to their use. A grantee or subgrantee may use results obtained from audits conducted under the Residential Conservation Service Program as part of the audit procedures which have been approved by the Operations Office Manager.

[49 FR 3629, Jan. 27, 1984, as amended at 50 FR 713, Jan. 4, 1985]

§ 440.22 Eligible dwelling units.

(a) A dwelling unit shall be eligible for weatherization assistance under this part if it is occupied by a family unit:

(1) Whose income is at or below 125 percent of the poverty level determined in accordance with criteria established by the Director of the Office of Management and Budget;

(2) Which contains a member who has received cash assistance payments under Title IV or XVI of the Social Security Act or applicable State or local law during the twelve-month period preceding the determination of eligibility for weatherization assistance; or

(3) If the State elects, is eligible for assistance under the Low-Income Home Energy Assistance Act of 1981, provided that such basis is at least 125 percent of the poverty level determined in accordance with criteria established by the Director of the Office of Management and Budget.

(b) A subgrantee may weatherize a building containing rental dwelling units using financial assistance for dwelling units eligible for weatherization assistance under paragraph (a) of this section, where:

(1) The subgrantee has obtained the written permission of the owner or his agent;

(2) Not less than 66 percent (50 percent for duplexes and four-unit buildings) of the dwelling units in the building:

(i) Are eligible dwelling units, or

(ii) Will become eligible dwelling units within 180 days under a Federal, State or local government program for rehabilitating the building or making similar improvements to the building; and

(3) The grantee has established procedures approved by the Operations Office Manager to insure that:

(i) Rents shall not be raised because of the increased value of dwelling units due solely to weatherization assistance provided under this part and

(ii) No undue or excessive enhancement shall occur to the value of the dwelling units.

[49 FR 3629, Jan. 27, 1984, as amended at 50 FR 713, Jan. 4, 1985]

§ 440.23 Oversight, training, and technical assistance.

(a) The Secretary and the appropriate Operations Office Manager, in coordination with the Secretary of Health and Human Services, shall monitor and evaluate the operation of projects carried out by CAA's receiving financial assistance under this part through on-site inspections, or through other means, in order to ensure the effective provision of weatherization assistance for the dwelling units of low-income persons.

(b) DOE shall also carry out periodic evaluations of a program and weatherization projects that are not carried out by a CAA and that are receiving financial assistance under this part.

(c) The Secretary and the appropriate Operations Office Manager, the Comptroller General of the United States, and for a weatherization project carried out by a CAA, the Secretary of Health and Human Services or any of their duly authorized representatives, shall have access to any books, documents, papers, information, and records of any weatherization project receiving financial assistance under the Act for the purpose of audit and examination.

(d) Each grantee shall ensure that audits by or on behalf of subgrantees are conducted with reasonable frequency, on a continuing basis, or at scheduled intervals, usually annually, but not less frequently than every two years, in accordance with OMB Circular A-102, Attachment P, and OMB Circular 110, Attachment F, as applicable.

(e) The Secretary may reserve from the funds appropriated for any fiscal year an amount not to exceed 10 percent to provide, directly or indirectly, training and technical assistance to any grantee or subgrantee. Such training and technical assistance may include providing information concerning conservation practices to occupants of eligible dwelling units.

§ 440.24 Recordkeeping.

Each grantee or subgrantee receiving Federal financial assistance under this part shall keep such records as DOE shall require, including records which fully disclose the amount and disposition by each grantee and subgrantee of the funds received, the total cost of a weatherization project or the total expenditure to implement the State plan for which assistance was given or used, the source and amount of funds for such project or program not supplied by DOE, and such other records as DOE deems necessary for an effective audit and performance evaluation. Such recordkeeping shall be in accordance with the DOE Financial Assistance Rule, 10 CFR Part 600 and any further requirements of this regulation.

(Approved by the Office of Management and Budget under control number 1904-0047)

§ 440.25 Reports.

DOE may require any recipient of financial assistance under this part to provide, in such form as may be prescribed, such reports or answers in writing to specific questions, surveys, or questionnaires as DOE determines to be necessary to carry out its responsibilities or the responsibilities of the Secretary of Health and Human Services under this part.

(Approved by the Office of Management and Budget under control number 1901-0127)

§ 440.26 Establishment of the Performance Fund.

The Secretary shall allot annually not less than five percent and no more than fifteen percent of the amount appropriated for each fiscal year for the program to a special Performance Fund, to be awarded to provide additional financial assistance under this part to the States which DOE determines demonstrated the best performance during the previous fiscal year in accordance with the evaluative criteria established in § 440.27 and the procedures established in § 440.28. DOE will announce the percentage chosen for the year in the Annual Grant Guidance issued to States.

[50 FR 49917, Dec. 5, 1985]

§ 440.27 Evaluating State Performance.

(a) *Information.* (1) DOE will evaluate annually the performance of each State in the program based on the criteria set forth in paragraphs (b), (c), and (d) of this section from the following information submitted to DOE by the State:

(i) The annual State Application under § 440.12 including:

(A) The State Plan,

(B) The Monitoring Plan, and

(C) The Training and Technical Assistance Plan;

(ii) Monthly and quarterly reports required pursuant to § 440.25; and

(iii) Any additional relevant information available to DOE.

(2) For the purposes of this Performance Fund, failure to submit these forms within 30 days after the end of the fiscal year will result in a score of zero for the applicable criterion.

(b) *Percent of units weatherized (Maximum Score: 25 points).* DOE will score the States according to the reported percentage of eligible dwelling units in the State weatherized during the relevant reporting period. A State's score for this criterion is determined by taking the number of dwelling units weatherized, as reported to DOE pursuant to § 440.25, dividing it by the number of dwelling units expected to be weatherized during the relevant reporting period as submitted by the State in accordance with § 440.14(b)(8)(ii), and multiplying the result by 25.

(c) *Comparable energy savings (Maximum Score: 25 points).* (1) DOE will award points to each State for the percentage of energy to be conserved in the State, as reported in the State Plan in accordance with § 440.14(b)(6), as follows:

(i) No points will be awarded for estimated energy savings of ten percent or less;

(ii) Five points will be awarded for estimated energy savings between eleven and twelve percent;

(iii) Ten points will be awarded for estimated energy savings between thirteen and fourteen percent;

(iv) Twelve points will be awarded for estimated energy savings between fifteen and sixteen percent;

(v) Fourteen points will be awarded for estimated energy savings between seventeen and eighteen percent;

(vi) Sixteen points will be awarded for estimated energy savings between nineteen and twenty percent;

(vii) Eighteen points will be awarded for estimated energy savings between twenty-one and twenty-two percent; and

(viii) Twenty-five points will be awarded for estimated energy savings of twenty-three percent or higher.

(2) If a State estimates energy savings to be greater than fourteen percent it must provide DOE with relevant information to support its estimates. To be acceptable to DOE for purposes of demonstrating energy savings, the study methodology must meet the following criteria:

(i) Monitor energy use over at least one complete heating/cooling period;

(ii) Use a scientifically selected random sample of homes weatherized in the State during the study period;

(iii) Use statistically sound, generally accepted data analysis techniques to measure and compare before and after energy use; and

(iv) Document study procedure and results.

(d) *Achievement of goals (Maximum Score: 50 points).* (1) DOE will award each State a maximum score as indicated for each of the following goals stated in the State's Application under § 440.12 and the State Plan under § 440.14:

(i) The production schedule indicating projected expenditures each month (§ 440.14(b)(1))—(maximum score 10 points);

(ii) The number of dwelling units to be weatherized during the relevant reporting period by category (§ 440.14(b)(2))—(maximum score 10 points);

(iii) The amount spent (at least forty percent) on weatherization materials (§ 440.14(b)(9) (ix))—(maximum score 10 points);

(iv) The average amount of funds (not to exceed an average of $1600) to be applied to a dwelling unit (§ 440.14(b)(9) (viii))—(maximum score 10 points);

(v) Compliance with the State Training and Technical Assistance Plan (§ 440.12(b)(7))—(maximum score 5 points); and

(vi) Compliance with the State Monitoring Plan (§440.12(b)(6))—(maximum 5 points).

(2) For each of paragraphs (d)(1) (i), (ii), (v), and (vi) of this section, a score will be awarded to a State by dividing the amount of actual achievement, as reported to DOE pursuant to § 440.25, by the goal stated in the State's Application, and multiplying the result by ten for paragraphs (b)(1) (i) and (ii), and multiplying the result by five for paragraphs (d)(1) (v) and (vi).

(3) For each of paragraphs (d)(1) (iii) and (iv) of this section, a State will be awarded ten points if it complies with the criterion and no points if the State fails to comply.

[50 FR 49917, Dec. 5, 1985]

§ 440.28 Awarding the Performance Fund.

(a) DOE will award funds from the Performance Fund to the twenty States annually determined to have demonstrated the best performance based on the criteria set forth in § 4440.27. If two or more States tie at the twentieth place, they will all qualify for the Performance Fund.

(b) At a minimum, the amount of funds from the Performance Fund to be awarded to a State will be the percentage of the State's tentative allocation that is equal to the percentage of funds reserved for the Performance Fund for that year.

(c) DOE will distribute the remaining money in the Performance Fund among the twenty States on the basis of their demonstrated ability to use program funds, except that no State will receive an amount equal to more than 50 percent of its tentative allocation. DOE will make this determination based primarily on the information provided by the States to DOE for the relevant reporting period, and possibly for other periods of time, in the Monthly Status Report, Standard Form 459E, which details the States' production and expenditures, and the Quarterly Financial Status Report, Standard Form 269.

[50 FR 49918, Dec. 5, 1985]

§ 440.29 Appeals.

(a) DOE will notify each State in writing of its score, ranking and the amount of funds, if any, to be awarded from the Peformance Fund.

(b) If a State believes a technical or clerical error was made in arriving at its score, the State may file an appeal in writing with the Assistant Secretary for Conservation and Renewable Energy, within ten days of receipt of notification, at the Office of Weatherization Assistance, U.S. Department of Energy, Mail Stop 5G-023, 1000 Independence Avenue, SW., Washington, DC 20585 and marked "Weatherization Assistance: Appeal."

(c) 10 CFR 205.131 and 205.134 provide the format for such a request.

(d) The appeal must adequately explain how DOE made a technical or clerical error.

(e) DOE shall consider the appeal and notify the State of DOE's final determination within 30 days of the receipt of the appeal, if at all possible.

[50 FR 49918, Dec. 5, 1985]

§ 440.30 Administrative review.

(a) An applicant shall have 20 days from the date of receipt of a decision under § 440.12 to file a notice requesting administrative review. If an applicant does not timely file such a notice, the decision under § 440.12 shall become final for DOE.

(b) A notice requesting administrative review shall be filed with the Operations Office Manager and shall be accompanied by a written statement containing supporting arguments and requesting, if desired, the opportunity for a public hearing.

(c) A notice or any other document shall be deemed filed under this section upon receipt.

(d) On or before 15 days from receipt of a notice requesting administrative review which is timely filed, the Operations Office Manager shall forward to the Deputy Assistant Secretary, the notice requesting administrative review, the decision under § 440.12 as to which administrative review is sought, a draft recommended final decision for the concurrence of the Deputy Assistant Secretary, and any other relevant material.

(e) If the applicant requests a public hearing, the Deputy Assistant Secretary, within 15 days, shall give actual notice to the State and FEDERAL REGISTER notice of the date, place, time, and procedures which shall apply to the public hearing. Any public hearing under this section shall be informal and legislative in nature.

(f) On or before 45 days from receipt of documents under paragraph (d) of this section or the conclusion of the public hearing, whichever is later, the Deputy Assistant Secretary shall concur in, concur in as modified, or issue a substitute for the recommended decision of the Operations Office Manager.

(g) On or before 15 days from the date of receipt of the determination under paragraph (f) of this section, the Governor may file an application, with a supporting statement of reasons, for discretionary review by the Assistant Secretary. On or before 15 days from filing, the Assistant Secretary shall send a notice to the Governor stating whether the Deputy Assistant Secretary's determination will be reviewed. If the Assistant Secretary grants review, a decision shall be issued no later than 60 days from the date review is granted. The Assistant Secretary may not issue a notice or decision under this paragraph without the concurrence of the DOE Office of General Counsel.

(h) A decision under paragraph (f) of this section shall be final for DOE if there is no review under paragraph (g) of this section. If there is review under paragraph (g) of this section, the decision thereunder shall be final for DOE, and no appeal shall lie elsewhere in DOE.

(i) Prior to the effective date of the termination of eligibility for further participation in the program because of failure to comply substantially with the requirements of the Act or of this part, a grantee shall have the right to written notice of the basis for the enforcement action and the opportunity for a public hearing notwithstanding any provisions to contrary of 10 CFR 600.26, 600.28(b), 600.29, 600.121(c), and 600.443. A notice under this paragraph shall be mailed by the Operations Office Manager by registered mail, return-receipt requested, to the State, local grantee, and other interested parties. To obtain a public hearing, the grantee must request an evidentiary hearing, with prior FEDERAL REGISTER notice, in the election letter submitted under Rule 2 of 10 CFR 1024.4 and the request shall be granted notwithstanding any provisions of Rule 2 to the contrary.

[55 FR 41326, Oct. 10, 1990]

APPENDIX A—STANDARDS FOR WEATHERIZATION MATERIALS

The following Government standards are produced by the Consumer Products Safety Commission and are published in Title 16, Code of Federal Regulations.

Thermal Insulating Materials for Building Elements Including Walls, Floors, Ceilings, Attics and Roofs Insulation—organic fiber—conformance to Interim Safety Standard 16 CFR Part 1209

Fire Safety Requirements for Thermal Insulating Materials According to Insulation Use—Attic Floor—insulation materials intended for exposed use in attic floors shall be capable of meeting the same flammability requirements given for cellulose insulation in 16 CFR Part 1209

Enclosed spaces—insulation materials intended for use within enclosed stud or joist spaces shall be capable of meeting the smoldering combustion requirements in 16 CFR Part 1209

The following standards which are not otherwise set forth in Part 440 are incorpoated by reference and made a part of Part 440. The following standards have been approved for incorporation by reference by the Director of the Federal Register. These materials are incorporated as they exist on February 27 and a notice of any change in these materials will be published in the FEDERAL REGISTER. The standards incorporated by reference are available for inspection at the Office of the Federal Register Information Center, Room 8301, 1100 L Street, NW., Washington, D.C. 20408.

Materials incorporated by reference are also available from the following sources:

American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pa. 19103
FS-Federal Specifications, General Services Administration, Specifications Section, Room 6039, 7th and D Streets, SW., Washington, D.C. 20407
American National Standards Institute, Inc., 1430 Broadway, New York, N.Y. 10018
Architectural Aluminum Manufacturers Association, 35 East Wacker Drive, Chicago, Ill. 60601
National Woodwork Manufacturers Association, 205 West Touhy Ave., Park Ridge, Ill. 60068
Fir and Hemlock Door Association, Yeon Building, Portland, Oregon 97204
Steel Door Institute, 712 Lakewood Center North, 14600 Detroit Ave., Cleveland, Ohio 44107
Steel Window Institute, 1230 Keith Building, Cleveland, Ohio 44115
National Electrical Manufacturers Association, 2101 L St., NW., Washington, D.C. 20037
American Society of Mechanical Engineers, United Engineering Center, 345 East 47th Street, New York, N.Y. 10017
American Gas Association, 1515 Wilson Boulevard, Arlington, Va. 22209
National Fire Protection Association, Batterymarch Park, Quincy, Mass. 02269
Air-Conditioning and Refrigeration Institute, 1501 Wilson Blvd., Arlington, Va. 22209
Sheet Metal and Air Conditioning Contractor's Association, 8224 Old Courthouse Road, Vienna, Va. 22180
Environmental Protection Agency, 401 M Street, NW., Washington, D.C. 20460
American Society of Heating, Refrigeration and Air-Conditioning Engineers, Inc., 2029 K Street, NW., Washington, D.C. 20006
Underwriters Laboratories, Inc., 333 Pfingsten Road, Northbrook, Ill. 60062
Office of Weatherization Assistance Program, Conservation and Renewable Energy, Mail Stop 5G-023, Forrestal Building, 1000 Independence Avenue, SW., Washington, D.C. 20585

THERMAL INSULATING MATERIALS FOR BUILDING ELEMENTS INCLUDING WALLS, FLOORS, CEILINGS, ATTICS, AND ROOFS

	Standards
Insulation—mineral fiber:	
Blanket	Conformance to ASTM[1] C665-78.
Roof insulation	Conformance to ASTM C726-81.
Loose-fill	Conformance to ASTM C764-73 (1979).
Insulation—mineral cellular:	
Vermiculite loose-fill	Conformance to ASTM C516-80.
Perlite loose-fill	Conformance to ASTM C549-81.
Cellular glass block	Conformance to ASTM C552-79.
Perlite board	Conformance to ASTM C728-82.
Insulation—organic fiber:	
Cellulosic fiber board	Conformance to ASTM C208-82.
Cellulose loose-fill	Conformance to Interim Safety Standard 16 CFR[2] Part 1209.
Insulation—organic cellular:	
Performed block-type polystyrene.	Conformance to ASTM C578-83.
Rigid performance urethane board.	Conformance to ASTM C591-69.
Polyurethane or polyisocyanurate board faced with aluminum foil.	Conformance to F.S.[3] HH-1-1972/1.
Polyurethane or polyisocyanurate board faced with felts.	Conformance to F.S. HH-1-1972/2.
Insulation—composite boards:	
Mineral fiber and rigid cellular polyurethane composite board.	Conformance to ASTM C726-81.
Perlite and rigid cellular polyurethane composite board.	Conformance to ASTM C984-83.
Gypsum board and polyurethane or polyisocyanurate composite board.	Conformance to F.S. HH-1-1972/4.
Materials used as a patch to reduce infiltration through the building envelope.	Commercial availability.

[1] ASTM indicates American Society for Testing and Materials.

[2] CFR indicates Code of Federal Regulations.

[3] F.S. indicates Federal Specification.

THERMAL INSULATING MATERIALS FOR PIPES, DUCTS, AND EQUIPMENT SUCH AS BOILERS AND FURNACES

	Standards
Insulation—mineral fiber:	
Performed pipe	Conformance to ASTM[1] C547-77.
Blanket and felt (industrial type).	Conformance to ASTM C553-70 (1977).

THERMAL INSULATING MATERIALS FOR PIPES, DUCTS, AND EQUIPMENT SUCH AS BOILERS AND FURNACES—Continued

	Standards
Blanket insulation and blanket type pipe insulation (metal-mesh covered) (industrial type).	Conformance to ASTM C592-80.
Block and board	Conformance to ASTM C612-83.
Spray-applied fibrous for elevated temperature.	Conformance to ASTM C720-72 (1979).
High temperature fiber blanket.	Conformance to ASTM C892-78.
Duct work	Conformance to ASTM C971-82.
Insulation—mineral cellular:	
Diatomaceous earth block and pipe.	Conformance to ASTM C517-71 (1979).
Calcium silicate block and pipe.	Conformance to ASTM C533-80.
Cellular glass block and pipe.	Conformance to ASTM C552-79.
Expanded perlite block and pipe.	Conformance to ASTM C610-67 (1974).
Insulation—organic cellular:	
Performed flexible elastomeric cellular in sheet and tubular form.	Conformance to ASTM C534-82.
Rigid preformed cellular urethane.	Conformance to ASTM C591-69.
Insulation—skirting	Commercially available.

[1] ASTM indicates American Society for Testing and materials.

FIRE SAFETY REQUIREMENTS FOR THERMAL INSULATING MATERIALS ACCORDING TO INSULATION USE

	Standards
Attic floor	Insulation materials intended for exposed use in attic floors shall be capable of meeting the same flammability requirements given for cellulose insulation in 16 CFR [1] Part 1209.
Enclosed spaces	Insulation materials intended for use within enclosed stud or joist spaces shall be capable of meeting the smoldering combustion requirements in 16 CFR Part 1209.
Exposed interior walls and ceilings.	Insulation materials, including those with combustible facings, which remain exposed and serve as wall or ceiling interior finish shall have a flame spread classification not to exceed 150 (per ASTM [2] E84.

FIRE SAFETY REQUIREMENTS FOR THERMAL INSULATING MATERIALS ACCORDING TO INSULATION USE—Continued

	Standards
Exterior envelope walls and roofs.	Exterior envelop walls and roofs containing thermal insulations shall meet applicable building code requirements for the complete wall or roof assembly.
Pipes, ducts, and equipment	Insulation materials intended for use on pipes, ducts, and equipment shall be capable of meeting a flame spread classification not to exceed 150 (per ASTM E84).

[1] CFR indicates Code of Federal Regulations.

[2] ASTM indicates American Society for Testing and Materials.

STORM WINDOWS

	Standards
Storm Windows:	
Aluminum Combination Unit.	Conformance to ANSI/AAMA [1] 1002.10-83.
Aluminum Frame	Conformance to Sections 1.2, 1.3, 1.4, and 1.6 of ANSI/AAMA 1002.10-83.
Wood Frame	Conformance to Section 3 of ANSI/NWMA [2] I.S. 2-80.
Rigid Vinyl Frame	Conformance to Sections 6.1 through 6.7; 6.12, and 6.13 of ASTM [3] D 4099-82.
Frameless Plastic Glazing	Required minimum thickness 6 mil (0.006 inches).
Movable Insulation Systems for windows.	Commercial Availability.
Shade Screens:	
—Fiberglass	Commercially available.
—Polyester	Commercially available.
Rigid Awnings:	
—Wood	Commercially available.
—Metal	Commercially available.
Louver Systems:	
—Wood	Commercially available.
—Metal	Commercially available.

[1] ANSI/AAMA indicates American National Standards Institute/Architectural Alumnium Manufacturers Association.

[2] ANSI/NWMA indicates American National Standards Institute/National Woodwork Manufacturers Association.

[3] ASTM indicates American Society for Testing and Materials.

STORM DOORS

	Standards
Storm Doors:	
Aluminum:	
—Frame	Conformance to ANSI/AAMA [1] 1102.7-1977.
—Siding	Conformance to ANSI/AAMA 1002.10-83.

STORM DOORS—Continued

	Standards
ood:	
ine	Conformance to Section 3 of ANSI/NWMA[2] I.S. 5–83.
–Fir, Hemlock, Spruce	Conformance to Section 3 of FHDA[3]/7–78.
–Rigid Vinyl	Conformance to ASTM[4] D 3678–81.
ibule: terials to construct vestibules.	Commercially available.

[1] ANSI/AAMA indicates American Standards Institute/Ar- ectural Aluminum Manufacturers Association.

[2] ANSI/NWMA indicates American National Standards In- /National Woodwork Manufacturers Association.

[3] FHDA indicates Fir and Hemlock Door Associations.

[4] ASTM indicates American Society for Testing Materials.

REPLACEMENT WINDOWS

	Standards
acement Windows:	
uminum frame	Conformance to ANSI/AAMA[1] 302.9–1977.
Steel frame	Conformance to Steel Window Institute Recommended Specifications for steel windows 1983.
ood frame	Conformance to ANSI/NWMA[2] I.S.2–80.
igid vinyl frame	Conformance to ASTM[3] D4099–82.

[1] ANSI/AAMA indicates American National Standards Insti- /Architectural Aluminum Manufacturers Association.

[2] ANSI/NWMA indicates American National Standards In- /National Woodwork Manufacturers Association.

[3] ASTM indicates Amercian Society for Testing and Materi-

REPLACEMENT DOORS

	Standards
lacement Doors:	
nged Doors	
–Steel	Conformance to SDI[1] 100–83.
–Wood	
Flush	Conformance to exterior door provisions of ANSI/NWMA[2] 1–80 Series.
Fire	Conformance to ANSI/NWMA I.S. 5–83.
Fir, hemlock, spruce	Conformance to FHDA[3]/7–78.
liding Patio Doors:	
–Aluminum	Conformance to ANSI/AAMA[4] 402.9–1977.
–Wood	Conformance to ANSI/NWMA I.S. 3–70.

[1] SDI indicates Steel Door Institute.

[2] ANSI/NWMA indicates American National Standards In- tute/National Woodworkers Manufacturers Association.

[3] FHDA indicates Fir and Hemlock Door Association.

[4] If multiple glazing is used, sealed insulating glass units preferred and should conform to ASTM E 774–81, "Standard Specifications for Sealed Insulating Glass Units."

CAULKS AND SEALANTS

	Standards
Caulks and Sealants:	
Putty	Conformance to F.S.[1] TT-P-00791P.
Glazing Compound	Conformance to ASTM[2] C669–79. (1981).
Oil and Resin Base	Conformance to ASTM C570–72 (1978).
Acrylic (Solvent Type)	Conformance to F.S. TT-S-00230C.
Butyl Rubber	Conformance to F.S. TT-S-001657.
Chlorosulfonated Polyethylene.	Conformance to F.S. TT-S-00230C.
Latex Sealing Compounds	Conformance to ASTM C834–76 (1981).
Elastomeric Joint Sealants (normally considered to include polysulfide, polyurethane, and silicone).	Conformance to ASTM C920–79.
Performed Gasket and Sealing Materials.	Conformance to ASTM C509–79.

[1] F.S. indicates Federal Specification.

[2] ASTM indicates American Society for Testing and Materials.

WEATHERSTRIPPING

	Standards
Weatherstripping	Commercial availability.

VAPOR BARRIERS

	Standards
Vapor Barrier	Selected according to the provisions cited in ASTM[1] C755–73 (1979); permeance not greater than 1 perm when determined according to the desiccant method described in ASTM E96–80.
Items to improve Attic ventilation.	Commercially available.

[1] ASTM indicates American Society for Testing and Materials.

CLOCK THERMOSTATS

	Standards
Clock Thermostats	Conformance to NEMA[1] DC 3–1978 or NEMA DC 15–1979 and performance test requirements.[2]

[1] NEMA indicates National Electrical Manufacturers Association.

[2] The performance tests requirements are: (1) the operating differential should not exceed 2°F, and (2) the effective operating droops should not exceed 4°F when determined according the applicable procedures in DC 3–1978 or DC 15–1979.

HEAT EXCHANGERS

	Standards
Heat Exchangers	ASME[1] Pressure Code provisions, as applicable to pressure levels. Standards of Tubular Exchanger Manufacturers Association (last edition with 1983 Addenda, TEMA).
With Gas Fired Appliances*	AGA[2] Requirement 70-1 for Gas Fueled Equipment. AGA Laboratories Certification Seal.

*The heat reclaimer is for installation in a section of the vent connector from appliances equipped with draft hoods or appliances equipped with powered burners or induced draft and not equipped with a draft hood.

[1] ASME indicates American Society of Mechanical Engineers.

[2] AGA indicates American Gas Association.

HOT WATER HEAT PUMPS

	Standards
Heat Pump Water Heaters	Listed by Underwriters Laboratories (UL) Standard for Electric Water Heaters Under Development. Efficiency Certification per Gas Appliance Manufacturers Association (GAMA) or Air Conditioning and Refrigeration Institute (ARI).

THERMOSTAT CONTROL SYSTEMS

	Standards
Automatic Set Back Thermostats.	Listed by Underwriters Laboratories (U.L.) Conformance to NEMA DC 15-1979.
Line Voltage or Low Voltage Room Thermostats.	NEMA DC 3-1978.
Automatic Gas Ignition Systems.	Conformance to ANSI Z21.21. AGA Laboratories Certification Seal.
Energy Management Systems.	Listed by Underwriters Laboratories (U.L.). Commercial availability.
Hydronic Boiler Control	Commercial availability.
Microcomputer Burner Control.	Commercial availability.

WATER HEATER MODIFICATIONS

	Standards
Insulate Tank and Distributing Piping.	(See Insulation Standards).
Install Heat Traps on Inlet and Outlet Piping.	Applicable local plumbing code.
How Water Pipe Heater Strips.	Listed by Underwriters Laboratories (U.L.).

WATER HEATER MODIFICATIONS—Continued

	Standards
Reduce Thermostat Settings	State or Local Recommenda- tions.
Install Stack, Damper, Gas Fueled.	ANSI Z21.67, including Ad- dendas A and B.-1978. ANSI Z223.1-1980.
Install Stack, Damper, Oil Fueled.	UL-17 NFPA[1] 31-1983.
Water flow modifiers	Commercially available.

[1] NFPA indicates National Fire Protection Association.

WASTE HEAT RECOVERY DEVICES

	Standards
Desuperheater/Water Heaters.	Conformance to ARI[1] 470- 80. Conformance to ARI 1060- 80.
Condensing Heat Exchangers.	Commercially available com- ponents and in new heat- ing furnace systems to manufacturers specifica- tions.
Condensing Heat Exchangers (Commercial, Multi-Story Building Institutional).	Commercially available with teflon lined tubes to manu- facturer specifications.
Energy Recovery Equipment	Energy recovery equipment and systems Air-to-Air (1978) Sheet Metal and Air Conditioning Contractors National Association (SMACNA).

[1] ARI indicates Air-Conditioning and Refrigeration Institute.

BOILER REPAIR AND MODIFICATIONS/ EFFICIENCY IMPROVEMENTS

	Standards
Installation of Gas Conversion Power Burners (for Gas or Oil Fired Systems).	In conformance with, or latest, ANSI Z21.8a, ANSI Z21.17 and Installation ANSI Z223.1-1980. AGA Laboratories Certifica- tion Seal.
Replacement Oil Burner	ANSI Z96.2-1980, (UL 296) ANSI Z91.2. NFPA 31-1983.
Power Burners (Oil/Gas)	Conformance to ANSI Z2231.1, National Fuel Gas Code; ANSI Z83.1 Gas Installations; NFPA 31 Oil Equipment.
Furnaces, Oil	Installation of oil burning equipment, NFPA 31-1978
Furnaces, Gas	Gas fired central furnace ANSI Z21.47-1983.
Re-Adjustment Boiler Water Temperature or Installation of Automatic Boiler Temperature Reset Control.	ANSI/ASME CSD.1-1982 applicable section of ANSI Z223.1-1980 and NFPA 31-1983.
Boilers	Boiler and pressure vessel code (eleven sections) ASME 1980 or latest Test- ing and Ratings Hydronic Institute (HYDI).

BOILER REPAIR AND MODIFICATIONS/EFFICIENCY IMPROVEMENTS—Continued

	Standards
Clean Heat Exchangers, Adjust Burner Air Shutter(s), Check Smoke No. on Oil Fueled Equipment. Check Operation of Pump(s) and Replace Filters.	Per manufacturer's instructions.
Combustion Chambers	Refractory linings may be required for conversions.
Heat Exchangers, Tubes	Protection from flame contact with conversion burners by refractory shield.
Thermostatic Radiator Valves	Commercially available. One pipe steam systems require steam air vents on each radiator, see manufacturer requirements.
Boiler Duty Cycle Control System.	Commercially available. National Electrical Code (NEC) and local electrical codes provisions for wiring.

HEATING AND COOLING SYSTEM REPAIRS AND TUNE-UPS/EFFICIENCY IMPROVEMENTS

	Standards
Duct Insulation	Conformance to FS HH-1-558B (See Insulation Sections).
Reduced Input of Burner, Derating Gas Fueled.[1]	In Conformance with Local Utility Company Procedures if applicable for gas fueled furnaces and Appendix H of NFPA 54 ANSI Z223.1.
Oil-Fired	Conformance to NFPA 31-1983, Standard for the Installation of Oil Burning Equipment.
Replacement Combustion Chamber, in Oil-Fired Furnace, Boiler.	Conformance to NFPA 31-1983.
Clean Heat Exchanger and Adjust. Burner: Adjust air shutter and check CO_2 and stack temperature—clean or replace air filter on forced air furnace.	See ANSI Z223.1, Appendix H.
Gas Fueled Heating Systems, Vent Dampers.	Conformance with applicable sections, National Fuel Gas Code including Appendices H, I, J and K. ANSI Z21.66-1977 and addenda A and B for Electrically Operated Dampers. ANSI Z21.68-1978 and Appendices A and B for Thermally Activated Vent Dampers. ANSI Z21.67-1978 and Appendices A and B for Mechanically Actuated Vent Dampers.

HEATING AND COOLING SYSTEM REPAIRS AND TUNE-UPS/EFFICIENCY IMPROVEMENTS—Continued

	Standards
Oil Fueled Systems, Vent Dampers.	Conformance with applicable sections of NFPA 31-1983 for installation and in conformance with UL 17.
Reduce Excess Dilution Air:	
(a) Reduction of Vent Connector Size of Gas Fueled Appliances.	See Part 9 of ANSI Z223.1-1980 and Appendix G and H.
(b) Adjustments of Barometric Draft Regulator for Oil Fuels.	NFPA 31-1980 for Air Fueled and per manufacturers' (furnace or burner) instructions.
Replacement of constant burning pilot with electric ignition device on gas fueled furnaces or boilers.	ANSI Z21.71-1981.
Readjustment of Fan Switch on Forced Air Gas or Oil Fueled Furnaces.[2]	In conformance with applicable sections; ANSI Z223.1-1980. Appendix H for Gas Furnaces and NFPA 31-1983 for Oil Furnaces.
Burners—See power burners, gas oil:	
Duct Furnaces (Gas)	ANSI Z223.1-1980, National Fuel Gas Code.
Heat Pumps	Listed by Underwriters Laboratories (U.L.).
Air Diffusing Equipment	Commercially available.
Outlets, Inlets, Air Flow	Do.
Warm Air Heating Metal Ducts.	Do.
Air Ducts and Connectors	Factory made air ducts and connectors (1981), UL 181.
Industrial-grade white paint used as a heat-reflective measure on awnings, window louvers, doors, and exterior duct work (exposed).	Commercially available.

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[1] This may be prohibited by local jurisdiction—it may also void the manufacturers warranty. The National Fuel Gas Code does not specifically endorse this.

[2] Applies also to forced air systems category.

REPLACEMENT FURNACES AND BOILERS

	Standards
Chimneys, fireplaces, vents and solid fuel-burning apparatuses.	NFPA[1] 211 (1984).
Gas-fired furnaces	NFPA 54/ANSI Z223.1.
Liquid petroleum gas standard.	NFPA 58.

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[1] NFPA indicates National Fire Protection Association.

[50 FR 713, Jan. 4, 1985]

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PART 445—INDUSTRIAL ENERGY CONSERVATION PROGRAM

Subpart A—General Provisions

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AUTHORITY: Secs. 5, 7, 13, Pub. L. 93-275, 88 Stat. 97 (15 U.S.C. 764, 766, 772); secs. 371-376, Pub. L. 94-163, 89 Stat. 871 (42 U.S.C. 6341-6346), as amended by Pub. L. 95-619, 92 Stat. 3207; secs. 301, 306; Pub. L. 95-91, 91 Stat. 565 (42 U.S.C. 7151, 7156); E.O. 11790 (39 FR 23185); E.O. 12009 (42 FR 46267).

SOURCE: 45 FR 10226, Feb. 14, 1980, unless otherwise noted.

Subpart A—General Provisions

§ 445.1 Purpose and scope.

This part sets forth the regulations for the Industrial Energy Conservation Program established under Part E of Title III of the Act. It includes criteria and procedures for the identification of reporting corporations, reporting requirements, criteria and procedures for exemption from filing reports directly with DOE, voluntary industrial energy efficiency improvement targets and voluntary recovered materials utilization targets. The purpose of the program is to promote increased energy conservation by American industry and, as it relates to the use of recovered materials, to conserve valuable energy and scarce natural resources.

§ 445.2 Definitions.

For the purpose of this part—

"Act" means the Energy Policy and Conservation Act (Pub. L. 94-163, 89 Stat. 971), as amended by the National Energy Conservation Policy Act (Pub. L. 95-619, 92 Stat. 3207).

"Btu" means British thermal unit.

"Chief executive officer" means, within a corporation or a sponsor, the chief executive officer or other individual who is in charge of the corporation or sponsor.

"Commercial quality production" means the manufacture of products suitable for shipment and/or sale.

"Control" means the ability to direct or cause the direction of the management and policies of a corporation. Whether control is present involves a question of fact to be determined from such criteria as a degree of ownership (especially of voting shares), contractual arrangements and other means of influence, such as ability to appoint a majority of a corporation's board of directors, whether by sufficient stock ownership or other means.

"Corporation" means a person as defined in section 3(2)(b) of the Act (any corporation, company, association, firm, partnership, society, trust, joint venture or joint stock company) and includes any person which controls, is controlled by, or is under common control with such person.

"DOE" means the Department of Energy.

"Energy efficiency" means the amount of energy in Btu's consumed per unit of production.

"Energy source" means electricity, purchased steam, natural gas, bituminous coal, anthracite, coke, ethane, propane, LPG, natural gasoline, gasoline (including aviation), special naphtha, kerosene, distillate fuel oil (including diesel), still gas, petroleum coke, residual fuel oil, crude oil, and any other material consumed as a fuel in manufacturing.

"Exempt corporation" means an identified corporation which DOE determines, pursuant to § 445.37, is not required to report directly to DOE.

"Feedstock" means petroleum products, natural gas or coal used as a raw material which is processed to become a part of the chemical composition of a manufactured product other than an energy source.

"Identified corporation" means a corporation identified by DOE in accordance with § 445.15. A corporation is an identified corporation for a year in which it consumed, in accordance with § 445.13, at least one trillion Btu's.

"Major energy-consuming industry" is an industry listed in § 445.5(a).

"Manufacturing" means the mechanical or chemical transformation of materials or substances into new products, as described on page 57 of the Office of Management and Budget Standard Industrial Classification Manual (1972).

"Manufacturing operation" means the mechanical or chemical transformation of materials or substances into a product classified with SIC codes 22, 26, 30, or 33; which is measured in a single unit of production. Manufacturing operations include, but are not limited to, the production of iron, steel, aluminum, copper, lead, zinc, wood pulp, paper, spun textile goods, woven textile goods, felt textile goods, nonwoven textile goods, tires and tire products, rubber footwear, and industrial rubber products.

"Obsolete scrap" means recovered materials created by the use and subsequent discard of a product. Examples are discarded tires, automobiles, and newspapers. This includes recovered materials from outside the United States which are used in manufacturing operations in the United States.

"Plant" means an economic unit of a corporation at a single physical location where manufacturing is performed.

"Plant report" means a duly completed report on the form provided by DOE for plant reporting in accordance with section 375(c) of the Act, or on such other form as provides information equivalent to that required to be reported on the form provided by DOE.

"Product" means an item or grouping of items (separate parts of, or all of a product line) that is the production of a manufacturing corporation that is classified within a major energy-consuming industry.

"Production" means the quantity of a corporation's product output, throughput, or activity.

"Program" means the Industrial Energy Conservation Program.

"Prompt industrial scrap" means recovered materials generated by an industrial process and used as input to a manufacturing operation other than the industrial process which generated it. An example is metal fabrication stamping waste which is used in manufacturing steel. This includes recovered materials from outside the United States which are used in manufacturing operations in the United States.

"Recovered materials" means any of the following energy-saving recovered materials: aluminum, copper, lead, zinc, iron, steel, paper and allied paper products, textiles, and rubber, recovered from solid waste.

"SIC" means the Standard Industrial Classification system described in the Office of Management and Budget

Standard Industrial Classification Manual (1972).

"Solid waste" means any garbage, refuse, sludge from a waste treatment plant, water supply treatment plant, or air pollution control facility and other discarded material including solid, liquid, semisolid, or contained gaseous material resulting from industrial, commercial, mining, and agricultural operations, and from community activities; but does not include solid or dissolved materials in domestic sewage, or solid or dissolved materials in irrigation flows, or industrial discharges which are point sources subject to permits under section 402 of the Federal Water Pollution Control Act, as amended (86 Stat. 880), or source, special nuclear or by-product material as defined by the Atomic Energy Act of 1954, as amended (68 Stat. 923).

"Sponsor" means a trade association or other person who operates or intends to operate a reporting program which collects data from one or more corporations.

"United States" means each of the several States, the District of Columbia, the Commonwealth of Puerto Rico, and any territory or possession of the United States.

"Waste" means "solid waste".

§ 445.3 Management of the program.

The Office of Industrial Programs, Office of the Assistant Secretary for Conservation and Solar Energy, Department of Energy, will implement and manage the program.

§ 445.4 Handling of information submitted under the program.

(a) Except as otherwise provided in this section, the handling of information submitted to DOE under this part shall be governed by DOE's Freedom of Information regulations, 10 CFR Part 1004.

(b) DOE will not disclose any information obtained under this part which is a trade secret or other matter described in 5 U.S.C 552(b) (4), disclosure of which may cause significant competitive harm, except to committees of Congress upon request of such committees; and information from plant reporting forms made available to DOE for verification purposes under § 445.26(a) shall not be released to the public.

(c) A corporation or sponsor which claims that information provided to DOE under this part is a trade secret or commercial or financial information that is privileged or confidential within the meaning of the Freedom of Information Act (FOIA) exemption in 5 U.S.C. 552(b) (4), and that disclosure of this information would cause significant corporate competitive damage, must so inform DOE by providing at the time of the submission of the information a detailed item-by-item explanation of whether the information is customarily treated as confidential by the corporation and the industry, and a detailed explanation of the anticipated competitive damage which would result from public disclosure.

(d) Prior to disclosing any information other than in response to a request made under 10 CFR Part 1004, DOE will grant any person who submitted information in accordance with paragraph (c) of this section an opportunity to comment on the proposed disclosure by providing at least seven days notice of DOE's determination to disclose such information. For purposes of this paragraph, notice is deemed to be given when mailed to the person who provided the information.

(e) Any information submitted to DOE by a corporation or sponsor under this part shall not be considered energy information, as defined by section 11(e) (1) of the Energy Supply and Environmental Coordination Act of 1974 (15 U.S.C. 796), for purposes of any verification examination authorized to be conducted by the Comptroller General under section 501 of the Act.

§ 445.5 Major energy-consuming industries.

(a) For purposes of this part, the following 2-digit SIC code manufacturing industries are the major energy-consuming industries:

(1) SIC 20—Food and kindred products;

(2) SIC 21—Tobacco products;

(3) SIC 22—Textile mill products;

(4) SIC 23—Apparel and other textile products;
(5) SIC 24—Lumber and wood products;
(6) SIC 25—Furniture and fixtures;
(7) SIC 26—Paper and allied products;
(8) SIC 27—Printing and publishing;
(9) SIC 28—Chemicals and allied products;
(10) SIC 29—Petroleum and coal products;
(11) SIC 30—Rubber and miscellaneous plastic products;
(12) SIC 31—Leather and leather products;
(13) SIC 32—Stone, clay and glass products;
(14) SIC 33—Primary metal industries;
(15) SIC 34—Fabricated metal products;
(16) SIC 35—Machinery, except electrical;
(17) SIC 36—Electric, electronic equipment;
(18) SIC 37—Transportation equipment;
(19) SIC 38—Instruments and related products; and
(20) SIC 39—Miscellaneous manufacturing industries.

(b) The following major energy-consuming industries are the industries for which reporting on the use of recovered materials is required under § 445.22(b):

(1) SIC 22—Textile mill products;
(2) SIC 26—Paper and allied products;
(3) SIC 30—(excluding Rubber products SIC 3079, as provided in § 445.22(d));
(4) SIC 33—Primary metal industries.

§ 445.6 Procedures for appeals.

Any appeal of a determination by DOE pursuant to any provision of this part shall be filed with the Office of Hearings and Appeals, U.S. Department of Energy, Washington, D.C. 20585, within 30 days of the date of that determination, pursuant to the procedures for such an appeal stated in 10 CFR Part 205, Subpart H. A person has not exhausted its administrative remedies until an appeal has been filed under that subpart, and an order granting or denying the appeal has been issued.

§ 445.7 General information-gathering authority.

In addition to the exercise of authority under Part E of Title III of the Act, DOE may exercise any authority available under any other provision of law to obtain such information with respect to industrial energy efficiency and industrial recovered materials use which it determines is necessary or appropriate to the attainment of the objectives of the program. Nothing in this part shall limit the authority of DOE to require reports of energy information under any other law.

Subpart B—Identification of Corporations

§ 445.11 Scope.

This subpart contains the criteria and procedures for the annual identification of corporations.

§ 445.12 Requirement for corporations to file a report on energy consumption.

(a) Except as provided by paragraph (b) of this section, a corporation which consumed, as determined according to § 445.13, at least one trillion Btu's of energy in a calendar year within a major energy-consuming industry shall file a report on that energy consumption with DOE as provided in § 445.14.

(b) Any corporation which was identified by DOE under § 445.15 within a major energy-consuming industry for a calendar year and which consumed, as determined according to § 445.13, at least one trillion Btu's of energy within the same major energy-consuming industry in the next calendar year, need not file a new report of its energy consumption in that industry.

(c) Any corporation which was identified by DOE under § 445.15 within a major energy-consuming industry for a calendar year and which consumed, as determined according to § 445.13, less than one trillion Btu's of energy within the same major energy-consuming industry in the next calendar year shall file a report on its energy consumption in that industry as provided by § 445.14. The failure of a corporation described in this paragraph to file a report may result in the continued identification of the corporation by DOE under § 445.15. (OMB control number 1904-0036)

[45 FR 10226, Feb. 14, 1980, as amended at 46 FR 63209, Dec. 31, 1981]

§ 445.13 Computation of energy consumption.

(a) For purposes of this subpart, energy consumed is the sum of the Btu contents of all energy sources consumed by a corporation in a manufacturing industry within the United States and includes energy used for—

(1) Direct manufacturing activities;

(2) Thermal self-generation of electricity;

(3) Heating, ventilating and air conditioning of manufacturing buildings and plant offices, as well as manufacturing services such as shops, cafeteria, other plant personnel services, and plant chemical and analytical laboratories;

(4) In-plant transportation, such as lift trucks, conveyors, cranes, and railroads;

(5) Transportation on a manufacturer's property between mining operations and manufacturing facilities;

(6) Raw material storage; and

(7) Services for finished product warehouses within a plant fence if directly related to manufacturing activities.

(b) For purposes of this subpart, energy consumed does not include (where such use is metered separately or can otherwise be identified)—

(1) All uses of electricity self-generated by thermal means;

(2) Services for corporate and divisional offices not contiguous to a plant;

(3) Services for basic research not contiguous to a plant;

(4) Services for regional distribution centers;

(5) Fuel for corporate aircraft, salesmen's cars and over-the-highway trucks;

(6) By-product fuels sold and shipped, or stored for sale;

(7) Facility start-up energy (to point of commerical quality production);

(8) Waste used as fuel;

(9) Transport of intermediate product to another producer for finishing within the same two-digit industry;

(10) Fuels received for storage for later disposition; and

(11) Feedstocks.

(c) For purposes of this section, where energy is consumed in manufacturing in one major energy-consuming industry for purposes of manufacturing an end product in another major energy-consuming industry, and such energy is not separately metered or cannot otherwise be identified, the energy is consumed in the major energy-consuming industry of the end product.

(d) To avoid double-counting in the case of thermally self-generated electricity, a corporation's electricity consumption shall be comprised only of purchased electricity and self-generated hydropower. For example, where a corporation consumes coal in the thermal generation of electricity for its own use, the Btu's of the coal, but not the Btu's of the electricity, shall be included.

(e) Where a corporation can measure or reliably estimate the Btu content of its energy sources (except electricity), energy consumed must be determined by reference to those actual or estimated Btu contents. Where a corporation cannot measure or reliably estimate the Btu contents of its energy sources, and in the case of electricity, the following conversion factors (Btu's/energy unit) must be used:

(1) Electricity, 3,412/kwh;
(2) Natural gas, 1,020/cu. ft;
(3) Bituminous coal, 22,565,000/short ton;
(4) Anthracite, 25,400,000/short ton;
(5) Coke, 26,000,000/short ton;
(6) Petroleum coke, 30,120,000/short ton;
(7) Ethane, 73,380/gal;
(8) Propane, 91,620/gal;
(9) LPG, 95,500/gal;
(10) Natural gasoline, 110,000/gal;
(11) Gasoline (including aviation), 124,950/gal;
(12) Special Naphtha, 124,950/gal;
(13) Kerosene, 135,000/gal;
(14) Distillate fuel oil (including diesel), 138,690/gal;
(15) Still gas, 400/cu. ft;
(16) Residual fuel oil, 149,690/gal;
(17) Crude Oil, 138,100/gal; and
(18) Other energy sources (including purchased steam), (to be determined by cal-

metric measurement or engineering standard as appropriate for consuming corporation).

§ 445.14 Report on energy consumption.

(a) The reports required by § 445.12 (a) and (c) must include the following information:

(1) The name, title, address and phone number of the individual responsible for reporting energy data for the corporation;

(2) The Internal Revenue Service "Employer Identification Number" (EIN) for the corporation; and

(3) The following statement, completed as appropriate:

———————— consumed at least
(name of corporation)
one trillion Btu's of energy in calendar year ——in SIC(s) ——— (For only those corporations filing pursuant to § 445.12(c) substitute or add the completed phrase: (and) consumed less than one trillion Btu's of energy in calendar year —— in SIC(s) ———), as determined according to 10 CFR 445.13. I certify that all the information in this report is true and accurate to the best of my knowledge.

———————— (Signature of Chief Executive Officer or individual designated by such officer)

———— Date of Submission

(b) Reports required by § 445.12 must be received by DOE by February 28 following the close of the calendar year for which the corporation is required to report and must be sent to the following address: Office of Industrial Programs, U.S. Department of Energy, Room 2H-085, 1000 Independence Avenue, SW., Washington, D.C. 20585. The deadline and address for submission of the report may be changed by DOE by the publication of a notice of the change in the FEDERAL REGISTER.

(c) Where a corporation controls, is controlled by or is under common control with another corporation, the corporation required to file the report is the corporation which controls.

(1) Where a corporation controls a joint venture, that corporation shall include the energy consumed by the joint venture in its energy consumption. Where more than one corporation controls a joint venture, each controlling corporation shall include in its energy consumption an equal percentage of the energy consumed by the joint venture during the calendar year for which the report is filed.

(2) Where a corporation is under common control, each controlling corporation shall include in its energy consumption an equal percentage of the energy consumer by the corporation under common control.

(3) A corporation shall supply to DOE, upon request, any material which DOE may require to verify control.

(d) All data used by a corporation in determining its energy consumption must be retained by the corporation for at least five years. (OMB control number 1904-0036)

[45 FR 10226, Feb. 14, 1980, as amended at 46 FR 63209, Dec. 31, 1981]

§ 445.15 Identification of corporations by DOE.

(a) Annually, after reviewing the information filed pursuant to § 445.12, and any other information on corporate energy consumption available to it, DOE will identify each corporation which consumed at least one trillion Btu's of energy within a major energy-consuming industry in the previous year, pursuant to the procedures set forth in paragraph (b) of this section.

(b) DOE will publish in the FEDERAL REGISTER a list identifying corporations. If this list must be supplemented, DOE may publish an updated list or may notify a corporation of its identification by certified mail.

§ 445.16 Request for modification.

(a) A corporation may file a request with DOE to modify its identification pursuant to § 445.15, on the grounds of clerical or technical error.

(b) Notwithstanding the provisions of § 445.6, the request must be filed with DOE within 30 days of the identification of the corporation, at the Office of Industrial Programs, U.S. Department of Energy, Room 2H-085, 1000 Independence Avenue, SW., Washington, D.C. 20585, and marked "Industrial Energy Conservation Program: Request for Modification." DOE may change the address for the submission of such requests by the publication of a notice of such change in the Federal Register.

(c) 10 CFR 205.131 and 205.134 provide the format for such a request.

(d) The request must adequately explain how the corporation erred in its report of energy consumption or how DOE erred in identifying the corporation.

(e) DOE shall respond to the request by granting or denying it within 20 days of the receipt of the request by the Office of Industrial Programs.

Subpart C—Reporting Requirements

§ 445.21 Plant reporting requirements.

(a) An identified corporation shall have at its headquarters in the United States a separate report on the progress each plant of the identified coporation has made during the reporting period in improving its energy efficiency in each major energy-consuming industry within which the corporation is identified.

(b) The reports required under paragraph (a) of this section must be prepared on a plant reporting form which has been—

(1) Published and made available for this purpose by DOE, or

(2) Developed and used by the identified corporation.

(c) The reports required under paragraph (a) of this section must be completed in a manner sufficiently timely to permit the data from such reports to be aggregated in the corporation's report required by § 445.22. (OMB control number 1904-0003)

[45 FR 10226, Feb. 14, 1980, as amended at 46 FR 63209, Dec. 31, 1981]

§ 445.22 Corporate reporting requirements.

(a) The chief executive officer (or individual designated by such officer) of each identified corporation shall report by the date specified in § 445.25 on the progress the corporation has made in improving its energy efficiency in each major energy-consuming industry within which the corporation is identified, including data aggregated from plant reports required under § 445.21.

(b) The chief executive officer (or individual designated by such officer) of each corporation identified within any of SIC(s) 22, 26, 30 or 33 also shall report by the date specified in § 445.25 on the progress the corporation has made to increase its utilization of recovered materials in each of these four industries within which the corporation is identified. (OMB control number 1904-0003)

(c) The information required under paragraphs (a) and (b) of this section must be submitted by SIC code—

(1) To DOE on a corporate reporting form which has been published and made available for this purpose by DOE, or

(2) For an exempt corporation, to a sponsor of an adequate reporting program on a corporate reporting form—

(i) Described in paragraph (c)(1) of this section, or

(ii) Which provides information equivalent to that required to be reported on the form described in paragraph (c)(1) of this section, accompanied by the certification required by the DOE form.

(d) Notwithstanding the requirements of paragraph (b) of this section, the chief executive officer of a corporation identified within SIC 30, all of whose manufacturing operations are within SIC 3079, (miscellaneous plastics products), shall not be required to report on the progress the corporation has made to increase its utilization of recovered materials in SIC 30.

[45 FR 10226, Feb. 14, 1980, as amended at 46 FR 63209, Dec. 31, 1981]

§ 445.23 Sponsor reporting requirements.

(a) The chief executive officer (or individual designated by such officer) of each sponsor of an adequate reporting program, as determined pursuant to § 445.37, shall report by the date specified in § 445.25 to DOE, as follows:

(1) For each major energy-consuming industry for which the sponsor has an adequate reporting program, on the progress the exempt corporations which participate in the adequate reporting program have made in improving their energy efficiency in that major energy-consuming industry, and

(2) For each of SIC(s) 22, 26, 30 and 33 for which the sponsor has an adequate reporting program, on the progress the exempt corporations which are required to report under § 445.22(b), and which participate in the adequate reporting program, have made to increase their utilization of recovered materials.

(b) The information required under paragraph (a) of this section must be submitted to DOE on a sponsor reporting form which has been—

(1) Published and made available for this purpose by DOE, or

(2) Previously supplied by the sponsor to DOE in its submission under § 445.35, accompanied by the certification required by the DOE form.

(c) Notwithstanding paragraph (a) of this section, a sponsor, in preparing its report, may aggregate data from reports filed with it by exempt corporations under § 445.22(c)(2) with data from reports by nonidentified corporations, only to the extent that the reports from the nonidentified corporations meet the requirements of § 445.22.

§ 445.24 Reporting period.

The reporting period for each report required by this subpart is the calendar year for which each corporation covered by the report is an identified corporation.

§ 445.25 Reporting date and address.

All reports submitted to DOE under this subpart must be received by DOE by the June 1 following the end of the reporting period and must be sent to the address provided in the instructions to the appropriate DOE form. This deadline and address may be changed by DOE by timely notification of such change to identified corporations and sponsors of adequate reporting programs.

§ 445.26 Data retention.

(a) All forms submitted to an identified corporation under § 445.21 and all other data used by that corporation in preparing reports under § 445.22, must be retained by the corporation for at least five years from the filing date and must be made available to DOE promptly upon request for verification. (OMB control number 1904-0003)

(b) All reports submitted by an exempt corporation to a sponsor under § 445.22(c)(2) must be retained by the exempt corporations for at least five years from the filing date. Upon request for verification the reports must be made promptly available to DOE by the corporation at its headquarters. (OMB control number 1904-0003)

(c) All data, other than reports described in paragraph (b) of this section, used by a sponsor in preparing reports submitted to DOE under § 445.23 must be retained by the sponsor for at least five years from the filing date and must be made available to DOE promptly upon request for verification. (OMB control number 1904-0003)

[45 FR 10226, Feb. 14, 1980, as amended at 46 FR 63209, Dec. 31, 1981]

Subpart D—Exemption Criteria and Procedures

§ 445.31 Scope.

This subpart contains the criteria and procedures for the exemption of identified corporations from the requirement of filing corporate reporting forms directly with DOE. These exemptions are effective for one year and renewable annually.

§ 445.32 Criteria for the exemption of corporations.

In order for an identified corporation to be exempt from filing the corporate report required by § 445.22 directly with DOE, pursuant to § 445.37, the corporation must—

(a) File a timely and complete request to be an exempt corporation pursuant to § 445.34;

(b) Participate in an adequate reporting program; and

(c) If it was previously determined to be an exempt corporation, have met the requirements of § 445.22(a), (b) and (c)(2) for the period it has been exempt.

§ 445.33 Criteria for adequate reporting programs.

In order for a reporting program of a sponsor to be determined an adequate reporting program for a major energy-consuming industry, pursuant to § 445.37, the sponsor must—

(a) File a timely and complete request to be a sponsor with an adequate reporting program, pursuant to § 445.35;

(b) If its program previously was determined to be adequate, have met the requirements of § 445.23 and have provided each identified corporation which participated in the reporting program with (1) specific written guidance for preparing and submitting the corporate report under § 445.22(c)(2) to the sponsor, and (2) a copy of the report which the sponsor filed with DOE under § 445.23.

§ 445.34 Request to be an exempt corporation.

(a) An identified corporation may seek an exemption by submitting a request to DOE describing its participation in an adequate reporting program.

(b) This request must include the following information:

(1) The name and address of the identified corporation,

(2) The name and telephone number of the person responsible for preparing the report required by § 445.22 on behalf of the corporation,

(3) The name, address, and telephone number of the sponsor in whose reporting program the corporation has arranged to participate, together with the enumeration of all major energy-consuming industries for which the corporation will submit reports to the sponsor;

(4) A statement that it will meet the requirements of § 445.22(a), (b) and (c)(2) and § 445.26 (a) and (b);

(5) A statement of how the corporation will report to the sponsor, either—

(i) On the DOE corporate reporting form, or

(ii) On some other reporting form, designated by the corporation; and

(6) A certification by the chief executive officer (or other individual designated by such officer) of the corporation as follows:

> I certify that all information provided in this request is true and accurate to the best of my knowledge.

(c) Notwithstanding the requirements of paragraph (a) of this section, any corporation which was exempt under § 445.37 for a calendar year and for which all information required by paragraph (b) of this section is unchanged, need not refile a request for the next year. (OMB control number 1904-0036)

[45 FR 10226, Feb. 14, 1980, as amended at 46 FR 63209, Dec. 31, 1981]

§ 445.35 Request to be a sponsor with adequate reporting programs.

(a) A sponsor may seek to have its reporting program determined to be adequate by submitting a request to DOE describing its reporting program.

(b) This request must include the following information:

(1) The name and address of the sponsor;

(2) The name and telephone number of the person responsible for preparing the report required by § 445.23 on behalf of the sponsor;

(3) A listing of each major energy-consuming industry covered by its reporting programs;

(4) A statement that the sponsor will meet the requirements of §§ 445.23 and 445.26(c);

(5) A statement of how the sponsor will submit the reports required by § 445.23 to DOE; either—

(i) On the DOE sponsor reporting form; or

(ii) On some other reporting form, designated by the sponsor;

(6) If the sponsor designates some other form, a copy of the form, together with an index referencing each and every item on the DOE form to the corresponding identical item on the form submitted;

(7) A statement that the sponsor will provide each identified corporation which participates in the reporting program with—

(i) Specific written guidance for preparing and submitting the corporate report under § 445.22(c)(2) to the sponsor; and

(ii) A copy of the report which the sponsor files with DOE under § 445.23; and

(8) A certification signed by the chief executive officer (or other indi-

individual designated by such officer) as follows:

I certify that all information provided in this request is true and accurate to the best of my knowledge.

(c) Notwithstanding the requirements of paragraph (a) of this section, a sponsor which was determined to have an adequate reporting program for a calendar year and for which all information required by paragraph (b) of this section are unchanged, need not refile a request for the next year, if its chief executive officer (or other individual designated by such officer) submits a certification that all items in the request filed the previous year are still true and accurate to the best of his knowledge. (OMB control number 1904-0036)

[6 FR 10226, Feb. 14, 1980, as amended at 6 FR 63209, Dec. 31, 1981]

§ 445.36 Filing deadline and address.

The requests made pursuant to § 445.34 and § 445.35 must be received by DOE by February 28 of each year and must be sent to the following address: Office of Industrial Programs, U.S. Department of Energy, Room 2H-065, 1000 Independence Avenue, S.W., Washington, D.C. 10585. DOE may change the deadline and address for submission of such requests by publishing a notice of such change in the FEDERAL REGISTER.

§ 445.37 Determination of exempt corporations and adequate reporting programs.

(a) Annually, in accordance with the criteria set forth in § 445.32 and § 445.33, DOE will exempt corporations and determine the adequacy of the reporting programs in which they participate, pursuant to the procedures set forth in paragraph (b) of this section.

(b) DOE will publish in the FEDERAL REGISTER for public comment its proposal to exempt corporations and to determine as adequate the reporting programs in which they participate. After considering comments from interested persons, DOE will exempt corporations and determine the adequacy of the reporting programs in which they participate by publishing a list of corporations and sponsors of programs in the FEDERAL REGISTER.

§ 445.38 Failure to report.

(a) If a sponsor of an adequate reporting program fails to submit the report required by § 445.23 by the deadline established in § 445.25, DOE may, by notice to the sponsor and to the identified corporations which participate in its program, revoke its determination that the sponsor has an adequate reporting program. Within 30 days after the notice is mailed, each such corporation must submit a corporate report directly to DOE as provided in § 445.22(c)(1).

(b) If a sponsor determines that an exempt corporation has failed to file a timely corporate report as required by § 445.22(c)(2), it should submit a report as required by § 445.23 only on those corporations which filed the corporate report with the sponsor. If an exempt corporation does not file the report required by § 445.22 with a sponsor, it must file the report required by § 445.22 directly with DOE.

Subpart E—Voluntary Energy Efficiency Improvement Targets and Voluntary Recovered Materials Utilization Targets

§ 445.41 Purpose and scope.

(a) This subpart contains the energy efficiency improvement targets and the recovered materials utilization targets established by DOE pursuant to section 374 and 374A of the Act.

(b) No liability shall attach to, and no civil or criminal penalties shall be imposed on, any corporation for any failure to meet any energy efficiency improvement target or any recovered materials utilization target contained in this subpart.

§ 445.42 Energy efficiency improvement targets.

(a) Each energy efficiency improvement target is a percentage figure which represents, for a major energy-consuming industry, the percentage reduction in energy consumption per unit of production which DOE has determined that such industry can achieve between calendar year 1972 and January 1, 1980, as established in 42 FR 29642, June 9, 1977, "Final Industrial Energy Efficiency Improvement Targets." Each target is set at a level which represents the maximum feasible improvement in energy efficiency that each industry can achieve.

(b) The energy efficiency improvement targets are set forth in Table I.

TABLE I

SIC code	Major energy-consuming industry	Target
20	Food and kindred products	12
22	Textile mill products	22
26	Paper and allied products	20
28	Chemicals and allied products	14
29	Petroleum and coal products	12
32	Stone, clay, and glass products	16
33	Primary metal industries	9
34	Fabricated metal products	24
35	Machinery except electrical	15
37	Transportation equipment	15

§ 445.43 Modification of energy efficiency improvement targets.

An energy efficiency improvement target in § 445.42 may be modified at any time if DOE—

(a) Determines that such target cannot reasonably be attained or could reasonably be made more stringent, and

(b) Publishes such determination in the FEDERAL REGISTER together with a statement of the basis and justification for the modification after providing an opportunity for public comment on any proposed modification.

§ 445.44 Recovered materials utilization targets.

(a) Recovered materials utilization targets are established for each of the following industries—textile mill products, paper and allied products, metals and metal products, and rubber.

(b) Each recovered materials utilization target is a percentage figure which represents, for each industry subdivision listed in paragraph (c) of this section, the amount of recovered materials from prompt industrial and obsolete scrap which DOE has determined can be used per unit of production by calendar year 1987. Each target is set at a level which represents the maximum feasible increase in the utilization of recovered materials which the industry can achieve progressively by January 1, 1987.

(c) The recovered materials utilization targets are set forth in Tables II, III, IV, and V.

TABLE II—TEXTILE MILL PRODUCTS

Industry subdivision	Recovered materials utilization target	Recovered materials utilization in reference year 197
Broad woven fabric mills, wool	13	13
Yarn mills, wool	13	13
Felt goods, except woven felt hats	80	[illegible]
Padding and upholstery filling	93	[illegible]
Nonwoven fabrics	15	17
Cordage and twine	22	22
All other textile mill products	0	0

TABLE III—PAPER AND ALLIED PRODUCTS

Industry subdivision	Recovered materials utilization target	Recovered materials utilization in reference year 197
Newsprint	18	14
Tissue	30	28
Printing and writing paper	6	7
Packaging and industrial converting papers	4	4
Unbleached kraft paperboard	10	4
Semichemical paperboard	26	28
Solid bleached paperboard	0	0
Recycled paperboard	106	[illegible]
Construction paper	55	[illegible]
Insulating and hard pressed board	17	22

TABLE IV—RUBBER

Industry subdivision	Recovered materials utilization target	Recovered materials utilization in reference year 197
Tires and tire repair materials	5	2
Rubber industrial products	5	3
Rubber footwear	15	0
Tire retreading and repair	12	0

TABLE V—METALS AND METAL PRODUCTS

Industry subdivision	Recovered materials utilization target	Recovered materials utilization in reference year 1976
Ferrous	41	38
Aluminum	35	30
Copper	50	47
Lead	60	51
Zinc	36	33

§ 445.45 Modification of recovered materials utilization targets.

Any recovered materials utilization target in § 445.44 may be modified if DOE—

(a) Determines that such target cannot reasonably be attained, or that the target should require greater use of recovered materials, and

(b) Publishes such determination in the FEDERAL REGISTER together with a basis and justification for the modification, after providing an opportunity for public comment on the proposed modification.

PART 450—ENERGY MEASURES AND ENERGY AUDITS

Subpart A—General Provisions

Sec.
450.1 Purpose and scope.
450.2 Uses of energy audit procedures.
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Subpart B—Information Audits

450.10 Purpose and scope.
450.11 Classes of, and requirements for, information audits.
450.12 Contents of information audits.
450.13 Auditors.
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Subpart C—Verification Audits

450.20 Purpose and scope.
450.21 Contents of verification audits.
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AUTHORITY: Part C of Title III, Energy Policy and Conservation Act, (42 U.S.C. 6321 et seq.), as amended by Part B of Title IV, Energy Conservation and Production Act, and Parts G and H of Title III, Energy Policy and Conservation Act, as added by Title III of the National Energy Conservation Policy Act, 92 Stat. 3206 *et seq.*; Department of Energy Organization Act, (42 U.S.C. 7101 *et seq.*)

SOURCE: 42 FR 33162, June 29, 1977, unless otherwise noted.

Subpart A—General Provisions

§ 450.1 Purpose and scope.

(a) This part designates energy measures and the types of, and requirements for, energy audits as required by the Department of Energy, pursuant to Section 432(d) of the Energy Conservation and Production Act, Pub. L. 94-385, 90 Stat. 1125 et seq., which adds Section 365(e) (1) and (2), 42 U.S.C. 6325(e) (1) and (2), to the Energy Policy and Conservation Act, 42 U.S.C. 6201 et seq.

(b) This part also contains the projections of future energy prices which shall be used in calculating the changes in energy costs which will result from installation of a particular modification in a building or industrial plant, and includes the criteria for determining whether the installation of a particular modication meets certain requirements of the Act for designation as an energy measure.

(c) This part also provides the requirements for the conduct of preliminary energy audits and energy audits in accordance with Section 393 and Section 400 C of the Energy Policy and Conservation Act, Pub. L. 94-163, 42 U.S.C. 6321, as amended by Title III of the National Energy Conservation Policy Act, Pub. L. 95-619, 92 Stat. 3206 *et seq.*

[42 FR 37800, July 25, 1977, as amended at 44 FR 19350, Apr. 2, 1979]

§ 450.2 Uses of energy audit procedures.

The requirements of this part shall be used—

(a) To establish minimum requirements for the type of energy audit to be carried out under a supplemental plan;

(b) To provide a process to measure the energy and cost savings to be derived from the installation or implementation of an energy measure; and

(c) To provide a process to identify a modification as an energy measure for purposes of the Act.

(d) To establish minimum requirements for the preliminary energy audits and energy audits to be carried out under the program of financial assistance for schools and hospitals and the program of financial assistance for units of local government and public care institutions.

[42 FR 33162, June 29, 1977, as amended at 44 FR 19350, Apr. 2, 1979]

§ 450.3 Definitions.

As used in this part—

"Act" means the Energy Conservation and Production Act, Pub. L. 94-385, 42 U.S.C. 6325.

"ANSI Standard" means a standard prescribed by the American National Standards Institute.

"Appliance" means an energy consuming article or device designed for household use, the primary purpose of which is labor saving or personal convenience and which, although connected to public utilities servicing a building, is not attached to the building in such a way that it would be considered part of the building or building system; for example, room air-conditioners, room heat pumps, room heaters, refrigerators, refrigerator-freezers, clothes washers and dryers, dishwashers, kitchen ranges and ovens, and television sets. Energy consuming articles or devices not classified as an appliance and considered part of a building or building system include, but are not limited to, water heaters, central heat pumps, central air-conditioners, and central heating units.

"Approved" means, with respect to an energy measure, any modification which is included on the list of energy measures published by DOE pursuant to section 365(e)(1), 42 U.S.C. 6325(e)(1), of the Energy Policy and Conservation Act.

"ASTM Standard" means a standard prescribed by the American Society for Testing and Materials.

"Attributed Life" means, with respect to an energy conservation measure, the time period which is equal to either the useful life or 15 years, whichever is less or, with respect to a renewable-resource energy measure, the time period which is equal to either the useful life or 25 years, whichever is less.

"Auditor" means any person who conducts an energy audit and certifies it to be in conformance with this regulation.

"British Thermal Unit" means the amount of heat required to raise the temperature of one pound of water from 59.5 to 60.5 degrees Fahrenheit at one atmosphere of pressure.

"Btu" means British thermal unit or units.

"Building" means any structure which includes provisions for a heating or cooling system, or both, or a hot water system, and which was constructed prior to August 14, 1976.

"Building Envelope" means all external building surfaces, such as walls, doors, windows, roof, and floors in contact with the ground, which are affected by weather.

"Climatic Zone" means a geographical area of the United States designated by DOE.

"Compressor Hours" means the average number of hours which an air conditioning compressor must operate to provide the cooling needed for space conditioning for a cooling zone.

"Cooling degree days" means the annual sum of the number of Fahrenheit degrees of each day's mean temperature above 65° for a given locality.

"Cooling Zone" means a climatic zone based on cooling degree days or compressor hours.

"Depletable Energy Resource" means a fossil fuel or nuclear fission fuel.

"Distillate Fuel" means those light and middle fuel oil derivatives from petroleum, such as kerosene, home heating oil, range oil, stove oil, diesel fuel, kerosene-type jet fuel, including Numbers 1, 2, 3, and 4 fuel oils.

"DOE" means the Department of Energy.

"Dual-Purpose Power Plant" means an equipment configuration which produces both electricity and useful thermal energy and which consumes, exclusive of the fuel required to produce the useful thermal energy, less than 7,500 Btu of fuel per kilowatt-hour of electricity produced.

"Dwelling Unit" means a house, including a stationary mobile home, an apartment, a group of rooms, or a single room occupied as separate living quarters.

"Energy Audit" means a process, carried out in accordance with this part, which identifies and specifies the energy and cost savings which are likely to be realized through the purchase and installation of an energy measure.

"Energy Conservation Measure" means a modification which has been determined by means of an energy audit or by DOE, by rule, to be likely to improve the efficiency of energy use and to reduce energy costs in an amount sufficient to enable a person to recover the total cost of purchasing and installing such measure, without regard to any tax benefit or Federal financial assistance applicable thereto, within the period of—

(1) The useful life of the modification involved; or

(2) Fifteen years after the purchase and installation of the modification, whichever is less.

The term does not include the purchase or installation of any appliance, any conversion from one fuel or source of energy to another which DOE, by rule, determines is ineligible on the basis that such type of conversion is inconsistent with national policy with respect to energy conservation or reduction of imports of fuels, or any measure or type of measure which does not have as its primary purpose an improvement in efficiency of energy use.

"Energy Measure" means an energy conservation measure or a renewable-resource energy measure.

"Federal Region" means one of the 10 standard regions as described in OMB Circular A-105, Standard Federal Regions.

"Heating degree days" means the annual sum of the number of Fahrenheit degrees of each day's mean temperature below 65° for a given locality.

"Heating Zone" means a climatic zone based on heating degree days.

"HVAC" means heating, ventilating and air conditioning.

"IEEE Standard" means a standard prescribed by the Institute of Electrical and Electronic Engineers.

"Industrial Plant" means any fixed equipment or facility which is used in connection with, or as part of, any process or system for industrial production or output and which was constructed prior to August 14, 1976.

"Industrial Process" means an action or series of actions in connection with, or part of, a process or system contributing to the production or output of an industrial plant.

"Liquefied Petroleum Gas" means propane, butane, propane/butane mixes, ethylene and ethane.

"LPG" means liquefied petroleum gas.

"Modification" means a change which can be purchased and installed in a building or industrial plant, and which can result in energy and cost savings.

"Nondepletable Energy Resource" means a type of energy resource other than a depletable energy resource.

"Regional Representative" means a Regional Representative of the Department of Energy.

"Renewable-Resource Energy Measure" means a modification which has been determined by means of an energy audit or by DOE, by rule, to—

(1) Involve changing, in whole or in part, the fuel or source of energy used to meet the requirements of such building or plant from a depletable source of energy to a nondepletable source of energy; and

(2) Be likely to reduce energy costs in an amount not less than the total cost of purchasing and installing such measure, without regard to any tax benefit or Federal financial assistance applicable thereto, within the period of—

(i) The useful life of the modification involved, or

(ii) Twenty-five years after purchase and installation of the modification, whichever is less. The term does not include the purchase or installation of any appliance.

"Residual Fuel" means Numbers 5 and 6 fuel oils, heavy diesel, Navy diesel, Bunker C and all other fuel oils which have a fifty percent boiling point over 700° F in the American Society for Testing Materials D-86 standard distillation test, as reapproved in 1972.

"R-Value" means a measurement of the ability of insulation to resist the flow of heat, expressed in English units at the mean temperature of the insulation under design conditions.

"Secretary" means the Secretary of the Department of Energy.

"Supplemental Plan" means a supplemental State energy conservation plan which is eligible for financial assistance under Part 420, Subchapter E, Chapter II of Title 10, Code of Federal Regulations.

"Useful Life" means that period of time for which a modification used under specified conditions is able to fulfill its intended function, and which does not exceed the period of remaining use of the building or that element of the industrial plant which is being modified.

[42 FR 33162, June 29, 1977, as amended at 42 FR 37800, July 25, 1977; 44 FR 19360, Apr. 2, 1979]

§ 450.4 Qualifying conditions.

(a) The primary purpose of a modification shall be an improvement in energy use efficiency only if the cost of the purchase and installation of the modification will be recovered, during its attributed life, by its projected energy cost savings, and results in an increase, with the use of the modification, in the energy efficiency index computed as required by § 450.21(b)(6).

(b) A modification shall result in an ineligible conversion if its implementation would result in an increase, expressed in Btu, at the building or industrial plant, in the consumption of petroleum products, natural gas, or a combination of the two.

(c) An increase in the consumption of petroleum products at a building or industrial plant shall not be an ineligible conversion, as provided by paragraph (b) of this section, if the increase will result from the installation of dual-purpose power plant equipment and DOE determines the modification would produce an off-setting reduction elsewhere in the consumption of petroleum products, natural gas, or a combination of the two.

(d) Projected prices for electricity, natural gas, distillate, residual fuel, LPG, and coal shall be derived from either—

(1) The projected energy prices set forth in Appendix A, Tables 1-20; or

(2) The following adjustment formulas—

(i) For petroleum products, coal, and natural gas—

$PA_t = PR_t - ((1985 - t)(PR_b - PA_b)/(1985 - b))$, for $t > 1985$

$PA_t = PR_t$, for $t \geq 1985$; and

(ii) for electricity:

$PA_t = PR_t \cdot PA_b / PR_b$, for all years;

(iii) where:

PA_t = projected fuel price for future year t;
PA_b = fuel price actually paid in base year b;
PR_b = regional fuel price for base year as set forth in Appendix A.
PR_t = projected regional fuel for future year t as set forth in Appendix A;

i—future year for which fuel price is being projected;
b—base year used in current DOE projection of fuel price, as shown in Appendix A.

Subpart B—Information Audits

§ 450.10 Purpose and scope.

This subpart establishes the classes of, and requirements for, the conduct of information audits, the qualifications of persons conducting Class A information audits and the allowable cost of information audits. Provisions for encouraging and carrying out information audits are required in a supplemental State energy conservation plan for which financial assistance is provided under Part 420, Subpart E, Chapter II of Title 10, Code of Federal Regulations.

§ 450.11 Classes of, and requirements for, information audits.

(a) A Class A information audit shall consist of—

(1) An on-site visit at the building or industrial plant by an auditor who has qualifications considered appropriate by a State; and

(2) An evaluation by an auditor of the building or industrial plant's energy consumption and energy systems, consisting of—

(i) An analysis of the energy and cost savings likely to result from the purchase and installation of one or more modifications selected by a State, or

(ii) General recommendations and a workbook, manual, or other instructional material enabling an owner, operator, or occupant of a building or industrial plant to calculate the energy and cost savings resulting from the purchase and installation of one or more modifications selected by a State.

(b) A Class B information audit shall consist of—

(1) A completed questionnaire, containing information provided by an owner, operator, or occupant of a building or industrial plant, which has been developed and distributed by a State; and

(2) An evaluation which analyzes the information obtained pursuant to paragraph (b)(1) of this section to identify the energy and cost savings likely to result from not less than two modifications selected by a State, taking into account such factors as heating and cooling degree days, fuel cost, and other data considered appropriate by a State, which evaluation shall be sent to the person who provided the information.

(c) A Class C information audit shall consist of—

(1) A workbook provided by a State, which will enable the owner, operator, or occupant of the building or industrial plant to identify the energy and cost savings for each of not less than four modifications selected by a State, which calculation shall take into account factors such as heating and cooling degree days, fuel prices, and other data considered appropriate by a State; and

(2) Pamphlets, books, brochures, or similar data, provided by a State, to be used in conjunction with the workbook referred to in paragraph (c)(1) of this section, regarding the purchase and installation of the modifications in the type of building or industrial plant for which the workbook is to be used.

§ 450.12 Contents of information audits.

(a) All three classes of information audits shall include an energy consumption description containing the following—

(1) For a building—

(i) Actual energy consumption by type of fuel by month for the preceding 12 months, except that where actual energy consumption data are not available, estimates of actual energy consumption and an explanation of the derivation of the estimates;

(ii) Cost of energy by type of fuel for the preceding 12 months;

(iii) Building profile, including description of—

(A) Location, climatic context, and immediate site conditions;

(B) Configuration, envelope, construction, and condition; and

(C) Heating, ventilating air conditioning, hot water and lighting systems;

(2) For an industrial plant—

(i) Actual energy consumption for both the industrial plant's building operations and its industrial processes, by type of fuel by month for the preceding 12 months, except that where actual energy consumption data are not available, estimates of actual energy consumption and an explanation of the derivation of the estimates;

(ii) Cost of energy by type of fuel for the preceding 12 months;

(iii) Description of the industrial plant's building characteristics, providing the information required by paragraph (a) (1) (iii) of this section;

(iv) Profile of the industrial plant's industrial processes, including a description of—

(A) The process layout and conditions within which it operates;

(B) material storage, handling, and processing; and

(C) All mechanical, electrical, hydraulic, and pneumatic systems, including those for waste handling; and

(v) Energy consumption of each process system by type of fuel.

(b) Each information audit shall identify and describe a modification sufficiently to enable the determination of the effects of the modification or combination of modifications on a building or industrial plant's energy consumption.

(c) Each information audit shall—

(1) Identify and describe, by the procedures set forth in § 450.21 or other appropriate procedures as prescribed by a State, subject to approval by DOE in the review of a State's supplemental plan, the total costs of purchasing and installing at least one modification, and the related energy and cost savings; and

(2) State whether or not projected energy cost savings attributable to the modification(s) are sufficient to recover the total cost of purchasing and installing the modification(s) within the attributed life of the modification(s).

(d) An information audit of an individual dwelling unit need not meet the requirements of paragraphs (a), (b), or (c) of this section if—

(1) The information audit uses the Project Conserve Questionnaire and related computer program, as revised from time to time by DOE, which DOE will make available to a State upon request;

(2) The information audit uses the Home Energy Savers Workbook (DOE Publication DOE/D-77/117), as amended by DOE from time to time; or

(3) A State develops an audit procedure which is determined by the Regional Administrator to meet or exceed the requirements of the material referred to in paragraphs (d) (1) and (2) of this section.

§ 450.13 Auditors.

Subject to the approval of the Regional Administrator, a State shall establish in its supplemental plan procedures for—

(a) Ascertaining that a person conducting a Class A information audit is qualified;

(b) Assuring full disclosure by an auditor of his or her financial interests relating to an audit or any modifications assessed by the audit; and

(c) Providing certification by the auditor to assure that each audit has been conducted in accordance with this regulation.

§ 450.14 Cost of information audits.

(a) An information audit conducted under a supplemental plan shall—

(1) For an individual dwelling unit, be conducted at no direct cost to the occupants of that dwelling unit; and

(2) For any building or industrial plant, not referred to in paragraph (a) of this section, be conducted at a cost which is less than—

(i) 10 percent of the building's or industrial plant's total energy costs for the preceding 12 months, when such energy costs were less than $40,000;

(ii) $4,000 or 5 percent of the building's or industrial plant's total energy costs for the preceding 12 months, whichever is greater, when such energy costs were equal to or greater than $40,000 but less than $1,000,000; or

(iii) $50,000 or 2.5 percent of the building's or industrial plant's total energy cost for the preceding 12 months, whichever is greater, when such energy costs were equal to or greater than $1,000,000.

(b) Subject to DOE review and approval, a State may establish procedures to permit information audit costs to exceed the limitations set forth in paragraph (a)(2) of this section in those cases where the State finds that buildings or industrial plants exhibit unique or unusually complex characteristics relating to energy use.

Subpart C—Verification Audits

§ 450.20 Purpose and scope.

This subpart prescribes guidelines for building and industrial process verification audits, which provide a detailed analysis of the changes in energy use and costs likely to result from the purchase and installation of an energy measure.

§ 450.21 Contents of verification audits.

(a) A verification audit shall contain an analysis of the actual or estimated energy consumption of the one or more building systems or industrial processes to be affected by the purchase and installation of a modification. The actual energy consumption of the building or industrial process shall be computed by type of fuel by month for a consecutive 12 months period; if available. Information in a verification audit shall include—

(1) Location, and immediate site conditions;

(2) Operating characteristics, which shall include—

(i) For a building, a description of the building configuration, construction and condition, and daily hours of use; and

(ii) For an industrial process, a description of the plant, process, and system layout, and operating conditions; and

(3) Actual energy consumption of the building or industrial process, by type of fuel per month, for the representative year selected, except that where actual energy consumption data are not available, estimates of actual energy consumption and an explanation of the derivation of the estimates.

(b) A verification audit shall identify and describe—

(1) The modification which is the subject of the audit, including when appropriate—

(i) The model and manufacturer;

(ii) Method of application to the building or industrial process;

(iii) Performance specifications, which may include engineering drawings;

(iv) Useful life; and

(v) For a modification under consideration as a renewable-resource energy measure, a description of the process by which the modification will convert one or more nondepletable energy resources to useful energy;

(2) All other modifications and energy conservation actions, including noncapital and operational changes such as reduced thermostat settings and changes in maintenance procedures and hours of operation, that are anticipated to be implemented by an owner, operator, or occupant of the building or industrial plant;

(3) All alternative modifications and energy conservation actions, including noncapital and operational changes, considered but rejected in favor of those modifications identified in paragraphs (b) (1) and (2) of this section and a brief explanation for the rejection;

(4) Future energy consumption for each year of the attributed life of the modification, by type of energy, in terms of both physical units, such as kilowatt-hours of electricity or barrels of distillate fuel, and equivalent Btu of energy resources consumed using the conversion factors specified in paragraph (b)(5) of this section under each of the following conditions—

(i) Without implementation of the modification identified in paragraph (b)(1) of this section, but including implementation of all of the modifications and energy conservation actions identified in paragraph (b)(2) of this section, if any; and

(ii) With implementation both of the modification identified in paragraph (b)(1) of this section and of all of the modifications and energy conservation actions identified in paragraph (b)(2) of this section, if any;

(5) For the purposes of paragraph (b)(4) of this section, the conversion

factors set forth in paragraph (a)(11) of § 450.42 shall be used.

(6) Whether or not the energy efficiency index, for a modification under evaluation as an energy conservation measure, computed with respect to paragraph (b)(4)(ii) of this section exceeds the energy efficiency index computed for paragraph (b)(4)(i) of this section, where the energy efficiency index is computed—

(i) For a building, by dividing the size of the building, expressed in terms of net square feet, by the number of Btu used in its operation; or

(ii) For an industrial process, by dividing the amount of production, consistently expressed in units, weight, or volume, achieved by the industrial process being modified, by the number of Btu used in its operation; and

(7) Whether the number of Btu of depletable energy resources, estimated to be consumed by a modification under evaluation as a renewable-resource energy measure, computed with respect to paragraph (b)(4)(ii) of this section is less than the number of Btu of depletable energy resources estimated to be consumed computed for paragraph (b)(4)(i) of this section.

(c) Costs and savings shall be presented in terms of constant dollars using the same base year as in the most current DOE projection of fuel prices set forth in Appendix A.

(d) A verification audit shall contain a finding that a modification will reduce energy costs sufficiently to recover purchase and installation costs within the attributed life of the modification if the net present value is either zero or a positive value. The net present value of implementing the modification shall be computed by the subcontracting the present value of purchase and installation costs calculated in accordance with paragraph (d)(1) of this section from the present value of energy cost savings calculated in accordance with paragraph (d)(2) of this section.

(1) The present value of purchase and installation cost shall be calculated by—

(i) Establishing the costs of purchasing and installing the modification, including the annual principal and interest payments on debt incurred, converted to base year dollars using the adjustment factors set forth in Appendix C: *Provided, however,* That the principal amount of indebtedness shall be used instead where it exceeds the sum of such adjusted principal and interest costs, and the costs of engineering design, less any salvage value of the existing equipment replaced by the modification;

(ii) Establishing future purchase and installation costs for normal replacement of significant components and parts of the modification, less the normal replacement costs of the equipment replaced by the modification and significant components of the equipment;

(iii) Deriving the yearly costs of operating and maintaining the modification less the costs that would be incurred for operating and maintaining the equipment replaced by the modification for the attributed life of the modification;

(iv) Computing the present value of the purchase and installation costs for each year of the attributed life of the modification by multiplying the costs derived in paragraphs (d)(1) (i), (ii), and (iii) of this section by the factors set forth in Appendix B; and

(v) Establishing the present value of the purchase and installation costs for the attributed life of the modification by adding together the yearly costs computed in paragraph (d)(1)(iv) of this section.

(2) The present value of energy cost savings assuming no change in building size or production level, shall be calculated by—

(i) Deriving fuel prices by type of fuel for each year of the attributed life of the modification using projected energy prices provided in § 450.4(d);

(ii) Establishing annual fuel costs for each year of attributed life of the modification by multiplying the fuel prices determined in paragraph (d)(2)(i) of this section by future energy consumption for each year, with and without the modification, as referred to in paragraph (b)(4) (ii) and (i) of this section, respectively, except that the conversion factor to be used for electricity for Tables 11—20 in Appendix A shall be 3412 useable Btu per kilowatt-hour;

(iii) Computing the net annual fuel costs for each year of the attributed life of the modification by subtracting the annual fuel cost with the modification from the annual cost without the modification, as provided in paragraph (d)(2)(ii) of this section;

(iv) Computing the present value of energy cost savings for each year of the attributed life of the modification by multiplying the values derived in paragraph (d)(2)(iii) of this section by the factors set forth in Appendix B; and

(v) Establishing the present value of energy savings for the attributed life of the modification by adding together the yearly savings computed in paragraph (d)(2)(iv) of this section.

(e) The contents of a verification audit shall be reduced to writing in the form of an audit report which shall contain the information and supporting documentation required by this section.

[42 FR 33162, June 29, 1977, as amended at 44 FR 19351, Apr. 2, 1979; 44 FR 61317, Oct. 26, 1979]

§ 450.22 Auditors.

(a) A person who conducts a building verification audit shall—

(1) Be a licensed professional engineer or architect;

(2) Have an engineering degree from a college or university accredited by the Engineers Council for Professional Development in addition to 4 years of subsequent experience in one or more of the following—

(i) Heating, ventilating and air conditioning installation or design work;

(ii) Building operations, including operation of the environmental systems;

(iii) Design of the building systems which are to be modified; or

(3) Be a certified Public Accountant in the State in which the audit is performed and use building and building systems data provided by—

(i) A Test and Balance Engineer as certified by the Associated Air Balance Council; or

(ii) A Testing, Adjusting, and Balancing Supervisor who is qualified by and employed by a firm that is certified by, the National Environmental Balancing Bureau.

(b) A person who conducts a verification audit of a residential building having less than three dwelling units shall meet—

(1) The requirements specified in paragraph (a) of this section; or

(2) Subject to the approval of DOE, other requirements which shall be prescribed by a Federal agency whose program utilizes such audits.

(c) A person who conducts an industrial process verification audit shall—

(1) Be a licensed professional engineer, or

(2) Have an engineering degree from a college or university accredited by the Engineers Council for Professional Development in addition to 4 years of subsequent experience with a relevant industrial process.

(d) Prior to conducting a verification audit, the auditor shall disclose in writing to the person for whom the audit is to be performed any significant financial interest held by the auditor, the auditor's spouse, or any child of the auditor, in a partnership, corporation, sole proprietorship, or other business enterprise engaged in the manufacturing, including manufacturing of major components marketing, installing, or servicing, of the modification which is the subject of an audit, or in the ownership or operation of the building or industrial plant which is the subject of an audit. A copy of the disclosure statement shall be signed by the auditor and shall accompany submission of the energy audit report or any portion thereof to DOE or any other agency, department or other instrumentality of the Federal Government.

(e) A financial interest shall be significant for the purposes of this section if it is one of the following—

(1) Employment, including employment as a consultant, by a partnership, corporation, sole proprietorship, or other business enterprise engaged in the manufacturing, marketing, installing, or servicing of the modification which is the subject of an audit or in the ownership or operation of the building or industrial plant which is the subject of an audit;

(2) Ownership of 10 or more percent of the stock, including options to purchase stock, or other securities issued

by a corporation, or of a 10 percent or more financial interest in any other business enterprise engaged in the manufacturing, marketing, installing, or servicing of a modification which is the subject of an audit or in the ownership or operation of the building or industrial plant which is the subject of an audit;

(3) A position as a director or officer of a corporation or partner in a partnership or active principal in a consortium or any other business enterprise engaged in the manufacturing, marketing, installing, or servicing of a modification which is the subject of an audit or in the ownership or operation of the building or industrial plant which is the subject of an audit;

(4) Participation in the profit-sharing program of a partnership, corporation, or other business enterprise engaged in the manufacturing, marketing, installing, or servicing of a modification which is the subject of an audit or in the ownership or operation of the building or industrial plant which is the subject of an audit; or

(5) Ownership of patent rights or other industrial property interests or the receipt of royalties therefrom for the manufacturing, installing, or servicing of a modification which is the subject of an audit.

(f) Each verification audit report shall include a statement signed by the auditor certifying that—

(1) The auditor meets the applicable qualifications set forth in this section;

(2) The auditor has made a full written disclosure of any significant financial interests in accordance with paragraph (d) of this section;

(3) The audit was conducted in accordance with the requirements of Subpart C of this part;

(4) The audit report required by § 450.21(e) and accompanying documentation accurately describe the audit findings; and

(5) The auditor understands that the report will be submitted to a department or agency of the United States which may rely on the contents of the material prepared by the auditor.

§ 450.23 Cost of verification audits.

(a) A verification audit shall be conducted without cost to the occupant of a dwelling unit.

(b) For any building or industrial plant not referred to in paragraph (a) of this section, a verification audit shall be conducted at a cost which is less than

(1) 10 percent of the building's or industrial plant's total energy costs for the preceding 12 months, when such energy costs were less than $40,000;

(2) $4,000 or 5 percent of the building's or industrial plant's total energy costs for the preceding 12 months, whichever is greater, when such energy costs were equal to or greater than $40,000 but less than $1,000,000; or

(3) $50,000 or 2.5 percent of the building's or industrial plant's total energy costs for the preceding 12 months, whichever is greater, when such energy costs were equal to or greater than $1,000,000;

(c) The Regional Administrator may grant exceptions to the limitation set forth in paragraph (b) of this section, when requested, if he determines upon specific review of a proposed audit that the audited building or plant exhibits unique or unusually complex characteristics relating to energy use and that the audit will therefore be unusually costly to perform.

Subpart D—Energy Measures

SOURCE: 42 FR 37800, July 25, 1977, unless otherwise noted.

§ 450.30 Purpose and scope.

This part establishes a list of energy conservation and renewable-resource energy measures developed by DOE after consultation with the Secretary of Housing and Urban Development. Depletion of the Nation's domestic resources of fossil fuels has created a need to identify energy measures which can be carried out in residential and commercial buildings and industrial plants.

§ 450.31 Energy conservation measures.

Subject to the requirements and limitations set forth in § 450.32, an energy conservation measure shall be—

(a) Ceiling insulation in a residential or commercial building, which is a material which is installed on the surface of the ceiling facing the builidng interior or between the heated top level living area and the unheated attic space and which resists heat flow through the ceiling;

(b) Wall insulation in a residential or commercial building or industrial plant, which is a material which is installed on the surface facing the building interior, or in the cavity, of an exterior wall and which functions to resist heat flow through the wall;

(c) Floor insulation in a residential or commercial building, which is a material which resists heat flow through the floor between the first level heated space and the unheated space beneath it including a basement or crawl space;

(d) Insulation for hot bare pipes in a residential or commercial building or industrial plant, which is a material which resists heat flow from the pipes to the surrounding space;

(e) (1) Caulks and sealants in a residential or commercial building or industrial plant, which are nonrigid materials placed in joints of buildings to prevent the passage of heat, air and moisture;

(2) Weatherstripping in a residential or commercial building or industrial plant, which consists of narrow strips of flexible material placed over or in movable joints of windows and doors to reduce the passage of air and moisture;

(f) Roof insulation in a commercial building or industrial plant, which is insulation placed on the surface of the roof facing the building interior or between a roof deck and its water repellent roof surface;

(g) Clock thermostat in a residential building, which is a temperature control device for interior spaces incorporating more than one temperature control point and a clock for switching from one control point to another;

(h) Exterior insulation for a hot water heater in a residential or commercial building or industrial plant, which is a material placed around the tank which resists the heat flow from the hot water heater to its surrounding space;

(i) Insulation for forced air ducts in a residential or commercial building or industrial plant, which is a material which resists heat flow from the duct to its surrounding space;

(j) Storm window in a residential or commercial building, which is an extra window, normally installed to the exterior, but which may be installed to the interior, of the primary or ordinary window, to increase resistance to heat flow and to decrease air infiltration;

(k) Efficient lighting fixture or lamp in a residential or commercial building or industrial plant, which is one which—

(1) Replaces an incandescent fixture or lamp with a type of lighting system including fluorescent, mercury vapor, metal halide, and high pressure sodium or ellipsoidal reflector lamps; or

(2) Replaces a mercury vapor fixture or lamp with a high pressure sodium lighting system.

(l) Mixing valve for a hot water supply line in a residential or commercial building or industrial plant, which is a type of valve mounted in the hot water supply line, close to the water heater, which mixes cold water with hot, reducing the temperature of the water in the hot water distribution system;

(m) Flow restrictor for hot water lines in a residential or commercial building or industrial plant, which is a device that limits the rate of flow of hot water from shower heads and faucets;

(n) Burner for oil fired heating equipment in a residential building, which is a device which atomizes the fuel oil, mixes it with air and ignites the fuel-air mixture, and is an integral part of an oil fired furnace or boiler, including the combustion chamber;

(o) Individual meters to replace a master meter for gas, electricity and hot water in a commercial building, which are meters that measure the consumption of gas, electricity or centrally distributed hot water for individual users, instead of the total consumption which is measured by a master meter;

(p) (1) New oil burner is a commercial building or industrial plant, which is a device that meters, atomizes, ignites and mixes the oil with air for the combustion process of a boiler; or

(2) New boiler controls in a commercial building or industrial plant, which are devices that sense the need for reducing or increasing the firing rate and change the combustion air and oil flow rate accordingly;

(q) Controls for lighting in a residential or commercial building or industrial plant, which are manual or automatic cut off switches for lighting systems that allow cut off of all lighting or a portion of the lighting systems when lighting is not required;

(r) Automatic HVAC control system in a commercial building or industrial plant, which is a device which adjusts the supply of heating or cooling to meet space conditioning requirements;

(s) High efficiency electric motor or motor controls in a commercial building or industrial plant, which replace an existing motor or motor controls, resulting in not less than a specified increase in efficiency at a specified level of use, as determined by DOE; and

(t) Whole house ventilation fan in a residential building, which is a fan which removes air from the inside of a residential building to the outside.

(u) Air source heat pump, which is a system which is part of the central heating system and which has the capability of extracting heat from a body of air and transferring this heat to a body of liquid or to another body of air for space conditioning purpose;

(v) Water source heat pump, which is a system which is part of the central heating system and which has the capability of extracting heat from a body of water and transferring this heat to another body of liquid or to a body of air for space conditioning purposes.

(Part B of Title IV of the Energy Conservation and Production Act, Pub. L. 94-385, 90 Stat. 1125 et seq.; also issued under Part C, Title III of the Energy Policy and Conservation Act, Pub. L. 94-163, 89 Stat. 871 et seq. (42 U.S.C. 6321 et seq.); Federal Energy Administration Act of 1974, as amended, Pub. L. 93-275 (15 U.S.C. 761 et seq.); Department of Energy Organization Act, Pub. L. 95-91, 91 Stat. 565 et seq. (42 U.S.C. 7101 et seq.); EO 11790, 39 FR 22165)

[42 FR 37800, July 25, 1977, as amended at 42 FR 61993, Dec. 8, 1977]

§ 450.32 Requirements and limitations for energy conservation measures.

(a) Ceiling insulation shall be that amount which is required to raise the total ceiling insulation in a heating zone as measured by an R-Value, to levels not greater than—

Heating zone	R-Value
0	[illegible]
1	[illegible]
2	[illegible]
3	[illegible]
4	[illegible]
5	[illegible]

(b) Wall insulation shall be eligible in heating zones 2, 3, 4, and 5.

(c) Floor insulation shall be that amount which is required to raise the total floor insulation in a heating zone, as measured by an R-Value, to levels not greater than—

Heating zone	R-Value
0	0
1	0
2	11
3	19
4	22
5	22

(d) Insulation for hot bare pipes shall be eligible in all climate zones.

(e) Caulks, sealants, and weatherstripping shall be eligible in all climate zones.

(f) Roof insulation shall be no greater than that amount which is required to raise the total insulation to the level of R-Value 20 in heating zone 5. In all other heating zones, this amount of roof insulation is eligible where the structure is air conditioned by an absorption chiller.

(g) Clock thermostats shall automatically change a temperature setting to match heating and cooling demands, and complete not less than one cycle of adjustment in a 24 hour period, in all climate zones.

(h) Exterior insulation for hot water heaters shall be no greater than that amount which is required to raise the total exterior insulation to the level of R-Value 19, in all climate zones.

(i) Insulation for forced air ducts shall be no greater than that amount which is required to raise the total insulation to the level of R-Value 19, in all climate zones.

(j) Storm windows shall be eligible in heating zones 2, 3, 4, and 5, provided that existing windows are single glazed.

(k) Efficient lighting fixtures and lamps shall produce more than twice the useful light per watt of the lighting system they replace, in all climate zones.

(l) Mixing valves for a hot water supply line shall be capable of manual adjustment of water temperature, without water shut off or disconnection, in all climate zones.

(m) Flow restrictors for hot water lines shall be eligible for all shower heads and faucets in all climate zones.

(n) Residential burners for oil fired heating equipment shall—

(1) Cost less than $340 installed;

(2) Be certified by the manufacturer to be capable of yielding an efficiency rating of 82 percent or higher in a new furnace as measured by a standard steady state efficiency test measuring CO_2 and stack temperature; and

(3) Replace inefficient burners, which shall be burners that cannot be adjusted using the procedures and tests prescribed in E.P.A. publication 600/2-75-069A, entitled Guidelines for Residential Oil Burner Adjustments, Oct., 1975, to perform at an efficiency not less than—

Zone	Efficiency after adjustment
0	0.57
1	.65
2	.69
3	.73
4	.74
5	.75

(o) Individual meters to replace master meters for gas, electricity and hot water shall be permitted in all climate zones.

(p) New commercial or industrial oil burners and controls shall—

(1) Replace oil burners that cannot maintain 10 percent CO_2 at ¼ firing rate, 11 percent CO_2 at ½ firing rate and 14 percent CO_2 at full firing rate, while producing less than number two smoke spot number for No. 2 oil or less than number three smoke spot number for No. 6 oil, using the test prescribed in ASTM Standard D2156-65 (70); and

(2) Be certified by the manufacturer to maintain 11 percent CO_2 at ¼ firing rate, 12.5 percent CO_2 at ½ firing rate, and 14.5 percent CO_2 at full firing rate, while producing less than number two smoke spot number for No. 2 oil or less than number three smoke spot number for No. 6 oil using the test prescribed.

(q) Controls for lighting shall be installed on a circuit having a wattage of more than 1,500 watts for automatic controls and 400 watts for manual branch circuit switches, in all climate zones.

(r) HVAC controls, in all climate zones, shall be—

(1) Automatic, turn down, time actuated thermostats;

(2) Steam controls, valves, thermostats, timers, or external temperature sensors to limit space temperatures;

(3) Economizer controls and systems to utilize outside air in lieu of conditioned air when outside air temperatures will assist;

(4) Controls to reduce air distribution volume to meet demand;

(5) Controls to reduce heating or air conditioning systems output to minimum levels during unoccupied periods; or

(6) Automated computer, microprocessor and logic controller associated with HVAC control.

(s) High efficiency motors or motor controls shall have substantially continuous annual use, 5,000 hours minimum, and shall increase efficiency of operation not less than—

Motor horsepower	Efficiency increase percentage points[1]
1.5	5.7
2	5.4

Motor horsepower	Efficiency increase percentage points [1]
5	3.9
7.5	3.9
10	3.4
15	3.0
20	2.4
25	2.3

[1] Efficiencies shall be determined by IEEE standard 112A method B, under ANSI standard C.50.2. Percentage points efficiency increase is the arithmetic sum of the efficiency of the new motor operation less the efficiency of the existing motor operation.

(t) Whole house ventilation fans shall have the capacity to provide one complete exchange of air in less than two minutes, provided that the residential buildings are air conditioned and located in cooling zones 1, 2, or 3.

(u) An air source heat pump must be evaluated by a verification audit in accordance with the procedures in Subpart C of this part to determine whether savings in a specific application are sufficient to recover the costs of purchase and installation within its attributed life.

(v) A water source heat pump must be evaluated by a verification audit in accordance with the procedures in Subpart C of this part to determine whether costs savings in a specific application are sufficient to recover the costs of purchase and installation within its attributed life.

(Part B of Title IV of the Energy Conservation and Production Act, Pub. L. 94-385, 90 Stat. 1125 et seq.; also issued under Part C, Title III of the Energy Policy and Conservation Act, Pub. L. 94-163, 89 Stat. 871 et seq. (42 U.S.C. 6321 et seq.); Federal Energy Administration Act of 1974, as amended, Pub. L. 93-275 (15 U.S.C. 761 et seq.); Department of Energy Organization Act, Pub. L. 95-91, 91 Stat. 565 et seq. (42 U.S.C. 7101 et seq.); EO 11790, 39 FR 23185)

[42 FR 37800, July 25, 1977, as amended at 42 FR 61093, Dec. 8, 1977]

§ 450.33 Renewable-resource energy measures.

Subject to the requirements set forth in § 450.34, a renewable-resource energy measure shall be a—

(a) Agricultural waste-fired boiler, which is a system which is partially or completely fueled by agricultural residues;

(b) Geothermal space heating or cooling system, which is a system that uses heat extracted from the earth for either electrical generation or space conditioning purposes; and

(c) Skylight, which is a device which is installed to replace small portions of a roof for the purpose of supplying a portion of the lighting requirements of a building;

(d) Solar electric dispersed photovoltaic system, which is a system which involves the use of small arrays of cells which convert solar radiation into electric power for on-site use;

(e) Solar powered pump, which is a system which captures energy radiated by the sun, and uses this energy to power a pump;

(f) Solar process heating system, which is a system which captures energy radiated by the sun for use in industrial or agricultural processes;

(g) Solar space heating or cooling system, which is a system which captures energy radiated by the sun, and uses it for space conditioning purposes;

(h) Solar water heater, which is a system which captures energy radiated by the sun, and uses it to heat water;

(i) Urban waste-fired boiler, which is a system which is partially or entirely fueled by refuse or a refuse derived fuel;

(j) Urban waste pyrolysis system, which is a system which uses urban wastes as a fuel and processes the wastes into a liquid or gaseous fuel;

(k) Water powered generator which is a system which captures and stores the energy contained in moving water and transforms this energy into electricity;

(l) Wind powered generator, which is a system which captures and stores the energy transmitted by the wind and transforms this energy into electric power;

(m) Wind powered water pump, which is a system which captures the energy transmitted by the wind and uses this energy to extract water from a reservoir;

(n) Wood-fired boiler, which is a system which is partially or completely fueled by wood or wood residues;

(o) Wood-fired stove, which is a stove fueled by wood and which is installed primarily for space conditioning purposes.

(Part B of Title IV of the Energy Conservation and Production Act, Pub. L. 94-385, 90 Stat. 1125 et seq; also issued under Part C, Title III of the Energy Policy and Conservation Act, Pub. L. 94-163, 89 Stat. 871 et seq. (42 U.S.C. 6321 et seq.); Federal Energy Administration Act of 1974, as amended Pub. L. 93-275 (15 U.S.C. 761 et seq.); Department of Energy Organization Act, Pub. L. 95-91, 91 Stat. 565 et seq. (42 U.S.C. 7101 et seq.); EO 11790, 39 FR 23185)

[42 FR 37800, July 25, 1977, as amended at 42 FR 61993, Dec. 8, 1977]

§ 450.34 Requirements for renewable-resource energy measures.

(a) Except as provided in paragraph (b) of this section, a renewable-resource energy measure listed in § 450.33 must be evaluated by a verification audit in accordance with the procedures in Subpart C of this part to determine whether cost savings in a specific application are sufficient to recover the costs of purchase and installation within the attributed life of the energy measure.

(b) A solar water heater shall not be required to be evaluated by a verification audit if it is a system which—

(1) Is installed in a residential building; and

(2) Replaces an electric resistance water heater; and

(3) Is purchased, installed, and maintained at a total cost which shall not exceed the maximum allowable cost which shall be computed by—

(i) Selecting the correct system life factor in the Federal Region in which the system will be installed for the attributed life of the solar heater specified by the manufacturer in the following table—

TABLE OF SYSTEM LIFE FACTORS

Federal region	Years			
	10	15	20	25
1	280	340	380	410
2	270	330	370	390
3	280	350	390	420
4	300	370	410	440
5	290	380	400	430
6	330	410	460	490
7	290	380	400	430
8	280	350	390	410
9	300	370	420	445
10	320	400	460	490

(ii) Multiplying the system life factor by the current year's electricity rate for water heating in effect for the user of the system to be installed expressed in cents per kilowatt hour; and

(iii) Multiplying the product by the percent of the total hot water demand the system will supply.

(Part B of Title IV of the Energy Conservation and Production Act, Pub. L. 94-385, 90 Stat. 1125 et seq; also issued under Part C, Title III of the Energy Policy and Conservation Act, Pub. L. 94-163, 89 Stat. 871 et seq. (42 U.S.C. 6321 et seq.); Federal Energy Administration Act of 1974, as amended, Pub. L. 93-275 (15 U.S.C. 761 et seq.); Department of Energy Organization Act, Pub. L. 95-91, 91 Stat. 565 et seq. (42 U.S.C. 7101 et seq.); EO 11790, 39 FR 23185)

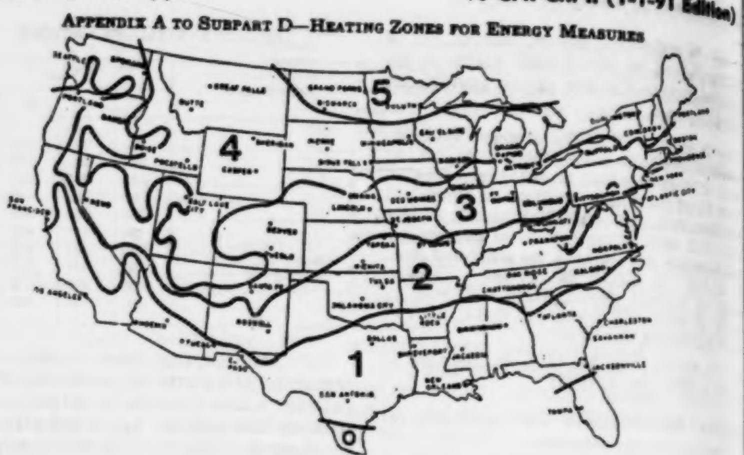
[42 FR 37800, July 25, 1977, as amended at 42 FR 61993, Dec. 8, 1977]

§ 450.35 Climate zones.

(a) DOE shall determine whether to restrict an energy measure to a climate zone.

(b) DOE shall designate climate zones, consisting of heating zones as shown in Appendix A to Subpart D or cooling zones as shown in Appendix B to Subpart D.

Appendix A to Subpart D—Heating Zones for Energy Measures

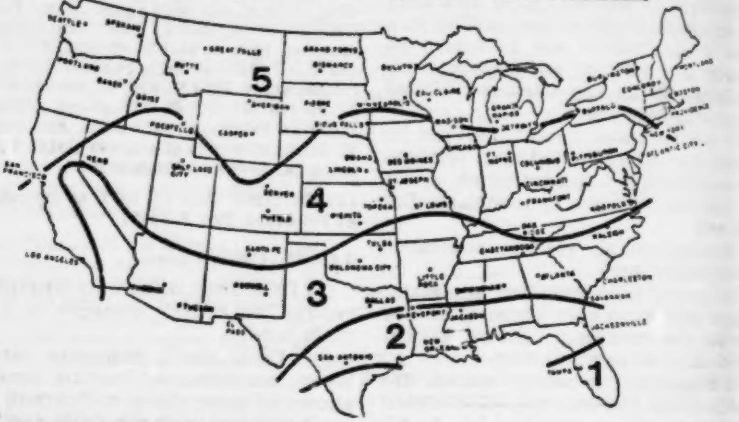


Notes

1. Alaska is included in Heating Zone 5.
2. Hawaii, Puerto Rico and the Virgin Islands are included in Heating Zone 0.

[42 FR 37800 July 25, 1977. Redesignated and amended at 44 FR 37939, June 29, 1979]

Appendix B to Subpart D—Cooling Zones for Energy Measures



Notes

1. Alaska is included in Cooling Zone 5.
2. Hawaii, Puerto Rico and the Virgin Islands are included in Cooling Zone 1.

[42 FR 37800 July 25, 1977. Redesignated and amended at 44 FR 37939, June 29, 1979]

Subpart E—Preliminary Energy Audits and Energy Audits

Authority: Title III of the National Energy Conservation Policy Act, Pub. L. 95-619, 92 Stat. 3206 *et seq.*, which establishes Parts G and H of Title III of the Energy Policy and Conservation Act, Pub. L. 94-163, 42 U.S.C. 6321 *et seq.;* Sec. 365(e)(2), 42 U.S.C. 6325(e)(2), of the Energy Conservation and Production Act, Pub. L. 94-385, 42 U.S.C. 6801 *et seq.;* Department of Energy Organization Act, Pub. L. 95-91, 42 U.S.C. 7101 *et seq.*

Source: 44 FR 19351, Apr. 2, 1979, unless otherwise noted.

§ 450.40 Purpose and scope.

This subpart establishes requirements for the conduct of preliminary energy audits and energy audits, the qualifications of persons conducting them and allowable costs of energy audits. Preliminary energy audits and energy audits are required in the program of financial assistance for schools and hospitals and the program of financial assistance for units of local government and public care institutions, as provided under Subpart B, Part 455, Chapter II of Title 10, Code of Federal Regulations.

§ 450.41 Definitions.

For purposes of this subpart—

"Building" means any structure, the construction of which was completed on or before April 20, 1977, which includes a heating or cooling system, or both.

"Complex" means a closely situated group of buildings on a contiguous site or a closely situated group of buildings served by a central utility plant, such as a college campus or a multi-building hospital.

"Construction completion" means the date of issuance of an occupancy permit for a building.

"Energy audit" means a survey of a building or complex that is conducted in accordance with the requirements of this subpart which—

(1) Identifies the type, size, energy use level and the major energy using systems;

(2) Determines appropriate energy conservation maintenance and operating procedures; and

(3) Indicates the need, if any, for the acquisition and installation of energy conservation measures, including solar energy and other renewable resource measures.

"Energy conservation maintenance and operating procedure" means modifications in the maintenance and operating procedures of a building, and any installations therein, which are designed to reduce energy consumption in such building and which require no significant expenditure of funds.

"Energy conservation measure" means an installation or modification of an installation in a building which is primarily intended to reduce energy consumption or allow the use of an alternative energy source, including, but not limited to—

(1) Insulation of the building structure and systems within the building;

(2) Storm windows and doors, multiglazed windows and doors, heat absorbing or heat reflective glazed and coated windows and door systems, additional glazing, reductions in glass area, and other window and door system modifications;

(3) Automatic energy control systems;

(4) Equipment required to operate variable steam, hydraulic, and ventilating systems adjusted by automatic energy control systems;

(5) Active or passive solar space heating or cooling systems, solar electric generating systems, or any combination thereof;

(6) Active or passive solar water heating systems;

(7) Furnace or utility plant and distribution system modifications including—

(A) Replacement burners, furnaces, boilers, or any combination thereof, which substantially increase the energy efficiency of the heating system;

(B) Devices for modifying flue openings which will increase the energy efficiency of the heating system;

(C) Electrical or mechanical furnace ignition systems which replace standing gas pilot lights; and

(D) Utility plant system conversion measures including conversion of existing oil- and gas-fired boiler installations to alternative energy sources, including coal;

(8) Caulking and weatherstripping;

(9) Replacement or modification of lighting fixtures to increase the energy efficiency of the lighting system without increasing the overall illumination of a building, unless such increase in illumination is necessary to conform to any applicable State or local building code or, if no such code applies, the increase is considered appropriate by the Secretary;

(10) Energy recovery systems;

(11) Cogeneration systems which produce steam or forms of energy such as heat, as well as electricity for use primarily within a building or a complex of buildings owned by a school or

hospital and which meet such fuel efficiency requirements as the Secretary may by rule prescribe;

(12) Such other measures as the Secretary identifies by rule for purposes of this part, as set forth in Subpart D of this part; and

(13) Such other measures as a grant application shows will save a substantial amount of energy and as are identified in an energy audit in accordance with Subpart C of this part.

"Fuel" means any commercial source of energy used within the building or complex being surveyed such as natural gas, fuel oil, electricity or coal.

"Gross square feet" means the sum of all heated or cooled floor areas enclosed in a building, calculated from the outside dimensions, or from the centerline of common walls.

"Heating or cooling system" means any mechanical system for heating or cooling areas of a building. For purposes of this subpart, any mechanical system for distributing air throughout the building is considered a cooling system.

"Hospital" means a public or nonprofit institution which is a general hospital, tuberculosis hospital, or any other type of hospital, other than a hospital furnishing primarily domiciliary care; and is duly authorized to provide hospital services under the laws of the State in which it is situated.

"Hospital facilities" means buildings housing a hospital and related facilities, including laboratories, laundries, outpatient departments, nurses' home and training facilities and central service facilities operated in connection with a hospital, and also includes buildings housing education or training facilities for health professions personnel operated as an integral part of a hospital.

"Indian tribe" means any tribe, band, nation, or other organized group or community of Indians, including any Alaska native village, or regional or village corporation, as defined in or established pursuant to the Alaska Native Claims Settlement Act, Pub. L. 92-203; 85 Stat. 688, which (a) is recognized as eligible for the special programs and services provided by the United States to Indians because of their status as Indians; or (b) is located on, or in proximity to, a Federal or State reservation or rancheria.

"Local educational agency" means a public board of education or other public authority or a non-profit institution legally constituted within, or otherwise recognized by, a State for either administrative control or direction of, or to perform administrative services for, a group of schools within a State.

"Maintenance" means activities undertaken in a building to assure that equipment and energy-using systems operate effectively and efficiently.

"Operating" means the operation of equipment and energy-using systems in a building to achieve or maintain specified levels of environmental conditions or service.

"Preliminary energy audit" means a determination of the energy consumption characteristics of a building, including the size, type, rate of energy consumption, and major energy-using systems of such building.

"Public care institution" means a public or non-profit institution which owns—

(1) A facility for long-term care, rehabilitation facility, or public health center, as described in Section 1633 of the Public Health Service Act (42 U.S.C. 300s-3; 88 Stat. 2270);

(2) A residential child care center, which is an institution, other than a foster home, operated by a public or non-profit institution and is primarily intended to provide full-time residential care with an average length of stay of at least 30 days for at least 10 minor persons who are in the care of such institution as a result of a finding of abandonment or neglect or of being persons in need of treatment or supervision.

"Public or nonprofit institution" means an institution owned and operated by—

(1) A State, a political subdivision of a State or an agency or instrumentality of either;

(2) A school or hospital which is, or would be in the case of such entities situated in America Samoa, Guam, Puerto Rico and the Virgin Islands, exempt from income tax under section 501(c)(3) of the Internal Revenue Code of 1954; or

(3) A unit of local government or a public care institution which is, or would be in the case of such entities situated in America Samoa, Guam, Puerto Rico and the Virgin Islands, exempt from income tax under section 501(c)(3) or 501(c)(4) of the Internal Revenue Code of 1954.

"School" means a public or nonprofit institution which—

(1) Provides, and is legally authorized to provide, elementary education or secondary education, or both on a day or residential basis;

(2)(A) Provides, and is legally authorized to provide, a program of education beyond secondary education, on a day or residential basis;

(B) Admits as students only persons having a certificate of graduation from a school providing secondary education, or the recognized equivalent of such certificate;

(C) Is accredited by a nationally recognized accrediting agency or association; and

(D) Provides an educational program for which it awards a bachelor's degree or higher degree or provides not less than a two-year program which is acceptable for full credit toward such a degree at any institution which meets the preceding requirements and which provides such a program;

(3) Provides not less than a one-year program of training to prepare students for gainful employment in a recognized occupation and which meets the provisions cited in paragraphs (A), (B), and (C) of paragraph (2) of this definition; or

(4) Is a local education agency.

"School facilities" means buildings housing classrooms, laboratories, dormitories, athletic facilities, or related facilities operated in connection with a school.

"State" means, in addition to the several States of the Union, the District of Columbia, Puerto Rico, Guam, American Samoa, and the Virgin Islands.

"Unit of local government" means the government of a county, municipality, parish, borough, or township, which is a unit of general purpose government below the State, determined on the basis of the same principles as are used by the Bureau of the Census for general statistical purposes; the District of Columbia, American Samoa, Guam and the Virgin Islands; the recognized governing body of an Indian tribe which governing body performs substantial governmental functions; libraries owned by any of the foregoing; and public libraries which serve all residents of a political subdivision below the State level, such as a community, district or region, free of charge and which derive at least 40 percent of their operating funds from tax revenues of a taxing authority below the State level.

§ 450.42 Contents of a preliminary energy audit.

(a) A preliminary energy audit shall provide a description of the building or complex audited and determine its energy-using characteristics, including—

(1) The name or other identification, and address of the building;

(2) A statement that the building meets the requirements of one of the following categories—

(i) A school facility;

(ii) A hospital facility; or

(iii) A building owned and primarily occupied either by offices or agencies of a unit of local government or by a public care institution, neither of which shall include any building intended for seasonal use or any building used primarily by a school or hospital;

(3) A description of the functional use made of the building identifying whether it is a—

(i) School—

(A) Elementary;

(B) Secondary;

(C) College or university;

(D) Vocational;

(E) Local education agency administrative building; or

(F) Other;

(ii) Hospital—

(A) General;

(B) Tuberculosis; or

(C) Other;

(iii) Local government building—

(A) Office;

(B) Storage;

(C) Service;

(D) Library;

(E) Police station;

(F) Fire station; or

(G) Other; or

(iv) Public care building—

(A) Nursing home;

(B) Long term care other than a nursing home;

(C) Rehabilitation facility;

(D) Public health center; or

(E) Residential child care center;

(4) The name and address of the owner of record, indicating whether owned by a public institution, private nonprofit institution or an Indian tribe;

(5) The size of the building, expressed in gross square feet;

(6) The age of the building;

(7) Approximate daily hours of operation, including periods of partial use if applicable;

(8) An indication of whether the building is partially used during vacation periods or other times when the building is not fully utilized, for periods of a week or more, by quarter;

(9) An identification of major energy-using systems, including—

(i) Type of heating system or cooling system or both;

(ii) Fuel used for heating system, cooling system;

(iii) Fuel used for domestic hot water, such as electric or natural gas;

(iv) Special energy using systems, such as food service or laundry; and

(v) Lighting, such as incandescent or fluorescent;

(10) Fuel use in physical units and cost data by type for a preceding 12 month period, by month if practicable, using actual data or an estimate if actual figures are unavailable;

(11) Total annual energy use expressed in Btu's per gross square foot and energy cost per gross square foot. Energy use shall be calculated using the conversion factors set forth below—

(i) Electricity—11,600 Btu per kilowatt hour.

(ii) Natural gas—1,030 Btu per cubic foot.

(iii) Distillate fuel oil—138,690 Btu per gallon.

(iv) Residual fuel oil—149,690 Btu per gallon.

(v) Coal—24.5 million Btu per standard short ton.

(vi) Liquified petroleum gases including propane and butane—95,475 Btu per gallon.

(vii) Steam—1,390 Btu per pound.

Conversion factors may be taken from engineering reference manuals for fuels not listed.

(b) A preliminary energy audit shall provide a brief description of activities which have been undertaken to conserve energy in the building or complex being audited, including whether—

(1) A person has been designated to monitor and evaluate energy use;

(2) Work partially or fully satisfying the requirements of an energy audit has been performed;

(3) Detailed studies have been conducted by architects, engineers or architect-engineer teams of energy use and energy conservation; and

(4) Any major energy conservation measures have been implemented, together with a listing of such measures, and estimates of their costs and energy savings if available.

(c) A preliminary energy audit shall provide information regarding site, building, and heating and hot water systems related to solar energy or other renewable resource potential including—

(1) An indication of whether open land, such as fields, yards and parking areas, is available within the immediate vicinity of the building which is not heavily shaded by tall buildings, trees or other obstructions;

(2) A statement of whether the building is located generally within an urban, suburban or rural area;

(3) An approximation of whether more than half the building's roof area or southern oriented wall surface is heavily shaded by shrubs, trees, buildings or other obstructions for more than about four hours per day;

(4) The number of stories;

(5) A general description of the building's shape, such as square, rectangular, E-shaped, H-shaped or L-shaped;

(6) An indication of whether the roof is flat or pitched, and if pitched whether it has a southern orientation;

(7) Whether there are existing rooftop obstructions, such as chimneys, space conditioning equipment, water towers, mechanical rooms, stairwells or other permanent structures;

(8) An indication of the exterior material of the southern facing wall, such as masonry, wood, aluminum;

(9) An approximation of the proportion of glass area of the southern facing wall, such as less than 25 percent, 25-75 percent, more than 75 percent;

(10) Location of primary space heating and water heating systems—

(i) Whether outside of or within the building;

(ii) If within the building, whether on the ground floor, in the basement, or on the roof; and

(iii) If within the building, whether centrally located, in multiple units, or a combination thereof.

§ 450.43 Contents of an energy audit.

(a) An energy audit shall contain the information required for a preliminary energy audit, in accordance with § 450.42, and shall also include a description of—

(1) Major changes in functional use or mode of operation planned in the next fifteen years, such as demolition, disposal, rehabilitation, or conversion from office to warehouse;

(2) For a building in excess of 100,000 gross square feet, if available—

(i) Peak electric demand for both daily and annual cycles; and

(ii) Annual energy use by fuel type of the major mechancial or electrical systems if the information is available or can be reasonably estimated;

(3) Terminal heating or cooling, or both, such as radiators, unit ventilators, fancoil units, or double-duct reheat systems;

(4) Building site and structural characteristics related to solar energy or other renewable resource potential, including but not limited to—

(i) Climatic factors, specifically—

(A) Average annual heating degree days and cooling degree days;

(B) Average solar insolation by month;

(C) Average monthly wind speed; and

(ii) Roof characteristics, including—

(A) An identification of primary structural component such as steel, wood, concrete; and

(B) Type of roofing material such as shingles, slate, or built-up materials; and

(5) A description of general building conditions.

(b) An energy audit shall—

(1) Indicate that appropriate energy conservation maintenance and operating procedures have been implemented for the building, supported by a demonstration based on actual records, that energy use has been reduced in a given year through changes in maintenance and operating procedures, by not less than 20 percent from a corresponding base period having a degree day variance of less than 10 percent; or

(2) Recommend appropriate energy conservation maintenance and operating procedures, on the basis of an onsite inspection and review of any scheduled preventive maintenance plan, together with a general estimate or range of energy and cost savings if practical, which may result from—

(i) Effective operation of ventilation systems and control of infiltration conditions, including—

(A) Repair of caulking or weatherstripping around windows and doors;

(B) Reduction of outside air intake, shutting down ventilation systems in unoccupied areas, and shutting down ventilation systems when the building is not occupied; and

(C) Assuring central or unitary ventilation controls, or both, are operating properly;

(ii) Changes in the operation of heating or cooling systems through—

(A) Lowering or raising indoor temperatures;

(B) Locking thermostats;

(C) Adjusting supply or heat transfer medium temperatures; and

(D) Reducing or eliminating heating or cooling at night or at times when a building or complex is unoccupied;

(iii) Changes in the operation of lighting systems through—

(A) Reducing illumination levels;

(B) Maximizing use of daylight;

(C) Using higher efficiency lamps; and

(D) Reducing or eliminating evening cleaning of buildings;

(iv) Changes in the operation of water systems through—

(A) Repairing leaks;

(B) Reducing the quantity of water used, e.g., flow restrictors;

(C) Lowering settings for hot water temperatures;

(D) Raising settings for chilled water temperatures; and

(v) Changes in the maintenance and operating procedures of the utility plant and distribution system through—

(A) Cleaning equipment;

(B) Adjusting air/fuel ratio;

(C) Monitoring combustion;

(D) Adjusting fan, motor, or belt drive systems;

(E) Maintaining steam traps; and

(F) Repairing distribution pipe insulation; and

(vi) Such other actions as the State may determine useful or necessary, consistent with the purposes of the energy audit and acceptable cost constraints of § 450.46.

(c) Based on information gathered under paragraphs (a) and (b) of § 450.42, and paragraphs (a)(1) and (3) of this section, an energy audit shall indicate the need, if any, for the acquisition and installation of energy conservation measures and shall include an evaluation of the need and potential for retrofit based on consideration of one or more of the following—

(1) An energy use index or indices, for example, Btu's per gross square foot per year;

(2) An energy cost index or indices, for example, annual energy costs per gross square foot; or

(3) The physical characterisitics of the building envelope and major energy-using systems.

(d) Based on information gathered under paragraph (c) of § 450.42 and paragraph (a)(4) of this section, an energy audit shall include an indication of whether building conditions or characteristics present an opportunity for use of solar heating and cooling systems or solar hot water systems.

(e) An energy audit may include an assessment of the estimated costs and energy and cost savings likely to result from the purchase and installation of one or more energy conservation measures.

[44 FR 19351, Apr. 2, 1979; 44 FR 61317, Oct. 26, 1979]

§ 450.44 Auditor qualifications.

Subject to the approval of the Secretary, a State shall develop procedures for establishing the qualifications of auditors who will conduct energy audits in accordance with Subpart B of 10 CFR Part 455 which—

(a) Ascertain that a person conducting the energy audit is qualified by virtue of successful completion of an approved training program or demonstration of equivalent skills gained by prior training and experience, together with familiarity with the systems and operations of the types of buildings being audited.

(b) Assure that the person responsible for the energy audit is not the person directly responsible for the day-to-day operation of the building being audited.

(c) Assure disclosure by an auditor of her or his financial interests relating to the energy audit or any energy conservation measures, including solar energy or renewable resource measures, reviewed or recommended by the audit.

§ 450.45 Audit reports.

(a) The results of a preliminary energy audit or an energy audit, conducted in accordance with the requirements of this subpart, shall be contained in an audit report. Unless a claim of confidentiality is made by an audited institution based upon a specific provision of the Freedom of Information Act, 5 U.S.C. 552, and both the claim and reason for confidentiality are submitted with the audit report or within 10 days from the date the owner receives the report, an audit report shall be considered public information and will be made available for public review upon request.

(b) Preliminary energy audit reports and energy audit reports shall be furnished to the State, and the owner and operator of the building audited.

(c) An audit report for an energy audit shall include a statement signed by the auditor that—

(1) The auditor meets the applicable qualifications as set forth in § 450.44;

(2) The auditor has indicated any financial interests in accordance with § 450.44; and

(3) The audit was conducted in accordance with the requirements of § 450.43.

(d) The audit report shall state that implementation of energy conservation maintenance and operating procedures are a condition for eligibility for receiving Federal assistance under the technical assistance program, described in 10 CFR Part 455.

§ 450.45 Cost of energy audits.

(a) Except as provided in paragraph (b) of this section, the allowable cost of an energy audit under this program for the purpose of calculating the Federal share thereof, shall not exceed the following—

Building gross square feet	Allowable cost for calculating Federal share
p to 30,000	$400.00
0,000 to 100,000	500.00
0,000 and above	600.00
Complex	[1]

[1] The sum of individual building allowances for the first 50,000 gross square feet, and 60 percent of individual building allowances above 150,000 gross square feet but not to exceed $10,000.

(b) Where necessary, States may increase the allowable cost of a particular energy audit, provided that the total of all such increases does not exceed 15 percent of the applicable State allocation. A State may permit increases for—

(1) The amount necessary to enable personnel from insitutions having few buildings or in remote locations to attend training sessions qualifying them to perform energy audits;

(2) The amount necessary to provide transportation to perform energy audits of buildings in remote locations; and

(3) The amount necessary to conduct energy audits for a building having an unusually complicated system or configuration; however, this increase may not exceed 50 percent of the allowable cost for an individual building.

APPENDIX A TO PART 450—ENERGY PRICE PROJECTIONS

1. Tables 1-10 show energy prices by fuel unit.

2. Tables 11-20 show energy prices per million useable Btu.

3. For the years following 1991, use 1991 prices.

4. DOE regions are comprised of the following:

REGION I—NEW ENGLAND

Maine, New Hampshire, Vermont, Rhode Island, Connecticut, Massachusetts

REGION II—NEW YORK/NEW JERSEY

New York, New Jersey, Puerto Rico,[1] Virgin Islands[1]

REGION III—MID-ATLANTIC

Pennsylvania, Delaware, Maryland, Virginia, West Virginia, District of Columbia

REGION IV—SOUTH ATLANTIC

North Carolina, South Carolina, Georgia, Florida, Kentucky, Tennessee, Alabama, Mississippi, Canal Zone[1]

REGION V—MIDWEST

Michigan, Ohio, Indiana, Wisconsin, Minnesota, Illinois

REGION VI—SOUTHWEST

Arkansas, Louisiana, Oklahoma, Texas, New Mexico

REGION VII—CENTRAL

Iowa, Missouri, Nebraska, Kansas

REGION VIII—NORTH CENTRAL

North Dakota, South Dakota, Montana, Wyoming, Colorado, Utah

REGION IX—WESTERN

Nevada, Arizona, California, Hawaii, American Samoa,[1] Guam,[1] Trust Territory of the Pacific Islands[1]

REGION X—NORTHWESTERN

Idaho, Washington, Oregon, Alaska

5. Column heading abbreviations mean as follows:

RES.—Residential Customer.
COMM.—Commercial Customer.
IND.—Industrial Customer.
ELECT.—Electricity.

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[1] Price projections not yet available. Until such time as they are made available, prices by the region indicated shall be applicable.

N. GAS—Natural Gas.
Dist.—Distillate Fuel.
RESID.—Residual Fuel.
LPG—Liquefied Petroleum Gas.
$/MKWH—Dollars per thousand kilowatt-hours.
$/MCFT—Dollars per thousand cubic feet.
$/BBL—Dollars per barrel.
$/MEST—Dollars per standard short ton (22.5 million Btu per ton).

TABLE 1—ENERGY PRICES IN 1977 DOLLARS PER FUEL UNIT; FEA REGION I—NEW ENGLAND

[Prices assumed constant from 1990 onward]

	Res. elect. $/ MKWH	Comm. elect. $/ MKWH	Ind. elect. $/MKWH	Res. N. gas $/ MCFT	Comm. N. gas $/ MCFT	Ind. N. gas $/ MCFT	Res. dist. $/BBL	Comm. dist. $/ BBL	Ind. dist. $/BBL	Comm. resid. $/ BBL	Ind. resid. $/BBL	Res. LPG $/BBL	Ind. LPG $/BBL	Ind. coal $/MEST
1975	49.58	48.27	35.32	3.47	2.88	2.44	20.06	17.75	17.75	14.66	14.73	15.61	13.32	28.46
1976	49.43	48.22	35.83	3.49	2.89	2.56	20.05	17.94	17.94	15.16	15.28	15.40	13.39	30.74
1977	49.28	48.17	36.34	3.51	2.89	2.69	20.05	18.13	18.12	15.66	15.83	15.19	13.46	33.02
1978	49.13	48.13	36.85	3.53	2.90	2.82	20.04	18.32	18.31	16.16	16.39	14.98	13.53	35.29
1979	48.98	48.08	37.36	3.54	2.91	2.94	20.04	18.51	18.50	16.66	16.94	14.77	13.60	37.57
1980	48.83	48.04	37.87	3.56	2.91	3.07	20.03	18.70	18.69	17.16	17.49	14.56	13.67	39.85
1981	48.75	48.06	38.49	3.72	3.07	3.09	20.22	18.89	18.88	17.20	17.53	14.75	13.87	40.19
1982	48.67	48.08	39.11	3.88	3.23	3.10	20.41	19.08	19.07	17.24	17.57	14.94	14.06	40.54
1983	48.60	48.10	39.73	4.04	3.39	3.12	20.61	19.27	19.26	17.28	17.61	15.14	14.26	40.89
1984	48.52	48.12	40.35	4.20	3.55	3.14	20.80	19.47	19.45	17.32	17.65	15.33	14.45	41.23
1985	48.44	48.15	40.97	4.36	3.71	3.16	20.99	19.66	19.65	17.36	17.69	15.53	14.64	41.58
1986	48.88	48.68	42.10	4.52	3.87	3.32	21.29	19.96	19.95	17.68	18.01	15.74	14.85	41.78
1987	49.31	49.21	43.23	4.69	4.04	3.49	21.59	20.26	20.24	18.00	18.33	15.95	15.05	41.98
1988	49.74	49.74	44.36	4.85	4.20	3.65	21.89	20.55	20.54	18.31	18.64	16.16	15.25	42.17
1989	50.17	50.27	45.49	5.02	4.37	3.82	22.18	20.85	20.84	18.63	18.96	16.37	15.46	42.37
1990	50.60	50.80	46.62	5.18	4.53	3.98	22.48	21.15	21.14	18.95	19.28	16.59	15.66	42.57
1991	50.60	50.80	46.62	5.18	4.53	3.98	22.48	21.15	21.14	18.95	19.28	16.59	15.66	42.57

TABLE 2—ENERGY PRICES IN 1977 DOLLARS PER FUEL UNIT; FEA REGION II—NEW YORK/NEW JERSEY

[Prices assumed constant from 1990 onward]

	Res. elect. $/ MKWH	Comm. elect. $/ MKWH	Ind. elect. $/MKWH	Res. N. gas $/ MCFT	Comm. N. gas $/ MCFT	Ind. N. gas $/ MCFT	Res. dist. $/BBL	Comm. dist. $/ BBL	Ind. dist. $/BBL	Comm. resid. $/ BBL	Ind. resid. $/BBL	Res. LPG $/BBL	Ind. LPG $/BBL	Ind. coal $/MEST
1975	55.70	56.00	30.33	2.83	2.30	1.71	18.26	16.60	16.53	14.32	14.32	12.92	11.65	23.76
1976	55.12	55.95	30.21	2.92	2.38	1.78	18.67	17.06	16.99	15.00	15.12	13.29	12.06	26.48
1977	54.53	55.91	30.09	3.02	2.46	1.84	19.09	17.53	17.45	15.68	15.92	13.65	12.47	29.20
1978	53.95	55.87	29.98	3.11	2.54	1.91	19.50	18.00	17.91	16.36	16.72	14.01	12.89	31.93
1979	53.37	55.82	29.86	3.20	2.62	1.97	19.91	18.46	18.37	17.04	17.52	14.37	13.30	34.65
1980	52.79	55.78	29.74	3.29	2.71	2.03	20.33	18.93	18.83	17.72	18.33	14.73	13.72	37.37
1981	52.33	55.86	29.79	3.43	2.84	2.17	20.55	19.15	19.05	17.76	18.37	14.95	13.94	37.72
1982	51.86	55.93	29.83	3.56	2.98	2.31	20.76	19.37	19.27	17.80	18.41	15.17	14.16	38.07
1983	51.40	56.01	29.88	3.70	3.12	2.44	20.98	19.58	19.49	17.84	18.44	15.39	14.38	38.41
1984	50.94	56.09	29.92	3.83	3.25	2.58	21.20	19.80	19.70	17.88	18.48	15.61	14.60	38.76
1985	50.48	56.17	29.96	3.97	3.39	2.72	21.42	20.02	19.92	17.92	18.52	15.84	14.82	39.10
1986	50.56	56.78	30.55	4.09	3.51	2.84	21.72	20.32	20.22	18.24	18.84	16.05	15.03	39.30
1987	50.64	57.40	31.13	4.21	3.63	2.95	22.02	20.62	20.52	18.56	19.16	16.26	15.24	39.50
1988	50.72	58.02	31.71	4.33	3.74	3.07	22.31	20.92	20.82	18.88	19.48	16.47	15.46	39.70

TABLE 2—ENERGY PRICES IN 1977 DOLLARS PER FUEL UNIT; FEA REGION II—NEW YORK/NEW JERSEY—Continued

[Prices assumed constant from 1990 onward]

	Res. elect. $/MKWH	Comm. elect. $/MKWH	Ind. elect. $/MKWH	Res. N. gas $/MCFT	Comm. N. gas $/MCFT	Ind. N. gas $/MCFT	Res. dist. $/BBL	Comm. dist. $/BBL	Ind. dist. $/BBL	Comm. resid. $/BBL	Ind. resid. $/BBL	Res. LPG $/BBL	Ind. LPG $/BBL	Ind. coal $/MEST
1989	50.80	58.84	32.30	4.45	3.86	3.19	22.61	21.22	21.12	19.19	19.80	16.66	15.67	39.80
1990	50.87	59.26	32.88	4.56	3.98	3.31	22.91	21.52	21.42	19.51	20.12	16.89	15.88	40.09
1991	50.87	59.26	32.88	4.56	3.98	3.31	22.91	21.52	21.42	19.51	20.12	16.89	15.88	40.09

TABLE 3—ENERGY PRICES IN 1977 DOLLARS PER FUEL UNIT; FEA REGION III—MID-ATLANTIC

[Prices assumed constant from 1990 onward]

	Res. elect. $/MKWH	Comm. elect. $/MKWH	Ind. elect. $/MKWH	Res. N. gas $/MCFT	Comm. N. gas $/MCFT	Ind. N. gas $/MCFT	Res. dist. $/BBL	Comm. dist. $/BBL	Ind. dist. $/BBL	Comm. resid. $/BBL	Ind. resid. $/BBL	Res. LPG $/BBL	Ind. LPG $/BBL	Ind. coal $/MEST
1975	41.77	38.85	27.36	2.19	1.87	1.22	17.81	16.53	16.40	14.25	14.04	11.65	10.96	18.32
1976	41.57	38.74	27.65	2.31	1.97	1.43	18.52	17.06	17.07	15.30	15.04	12.49	11.68	21.66
1977	41.36	38.64	27.94	2.44	2.07	1.63	19.23	17.60	17.73	16.36	16.04	13.34	12.36	25.05
1978	41.15	38.53	28.22	2.57	2.17	1.84	19.94	18.13	18.40	17.41	17.05	14.19	13.07	28.41
1979	40.94	38.43	28.51	2.70	2.27	2.04	20.64	18.66	19.06	18.47	18.05	15.03	13.77	31.78
1980	40.73	38.32	28.80	2.83	2.38	2.24	21.35	19.19	19.72	19.52	19.05	15.88	14.47	35.14
1981	40.98	38.68	29.57	2.95	2.50	2.31	21.56	19.40	19.93	19.56	19.09	16.11	14.70	35.49
1982	41.23	39.04	30.35	3.07	2.62	2.38	21.77	19.61	20.14	19.60	19.13	16.34	14.93	35.84
1983	41.47	39.40	31.12	3.20	2.75	2.45	21.98	19.82	20.35	19.64	19.17	16.57	15.16	36.18
1984	41.72	39.76	31.90	3.32	2.87	2.52	22.19	20.03	20.56	19.68	19.21	16.80	15.39	36.53
1985	41.96	40.12	32.67	3.44	2.99	2.58	22.40	20.24	20.77	19.72	19.25	17.03	15.61	36.88
1986	42.30	40.56	33.53	3.54	3.09	2.68	22.70	20.54	21.07	20.04	19.57	17.23	15.82	37.03
1987	42.63	41.00	34.39	3.63	3.18	2.78	22.99	20.84	21.37	20.36	19.89	17.43	16.02	37.17
1988	42.96	41.44	35.24	3.73	3.28	2.88	23.29	21.14	21.67	20.68	20.21	17.64	16.22	37.322
1989	43.29	41.88	36.10	3.82	3.37	2.97	23.59	21.44	21.96	21.00	20.53	17.84	16.43	37.47
1990	43.63	42.32	36.96	3.92	3.46	3.07	23.89	21.74	22.26	21.32	20.84	18.04	16.63	37.82
1991	43.63	42.32	36.96	3.92	3.46	3.07	23.89	21.74	22.26	21.32	20.84	18.04	16.63	37.82

TABLE 4—ENERGY PRICES IN 1977 DOLLARS PER FUEL UNIT; FEA REGION IV—SOUTH ATLANTIC

[Prices assumed constant from 1990 onward]

	Res. elect. $/MKWH	Comm. elect. $/MKWH	Ind. elect. $/MKWH	Res. N. gas $/MCFT	Comm. N. gas $/MCFT	Ind. N. gas $/MCFT	Res. dist. $/BBL	Comm. dist. $/BBL	Ind. dist. $/BBL	Comm. resid. $/BBL	Ind. resid. $/BBL	Res. LPG $/BBL	Ind. LPG $/BBL	Ind. coal $/MEST
1975	30.74	32.20	19.82	1.69	1.34	0.94	17.94	16.53	16.40	12.72	12.86	10.98	10.15	21.78
1976	31.66	33.02	21.30	1.81	1.43	1.04	18.70	17.07	17.06	13.64	13.71	11.98	11.04	25.24
1977	32.59	33.85	22.78	1.94	1.53	1.15	19.46	17.61	17.71	14.56	14.56	12.98	11.93	28.71
1978	33.51	34.67	24.26	2.07	1.63	1.25	20.22	18.14	18.36	15.48	15.41	13.97	12.82	32.17
1979	34.44	35.49	25.74	2.19	1.73	1.35	20.99	18.68	19.01	16.40	16.27	14.97	13.71	35.64
1980	35.36	36.41	27.22	2.32	1.83	1.45	21.75	19.22	19.67	17.31	17.12	15.97	14.60	39.10
1981	35.46	36.30	27.90	2.45	1.95	1.61	21.96	19.43	19.88	17.36	17.16	16.21	14.85	39.50
1982	35.56	36.29	28.58	2.57	2.08	1.76	22.16	19.63	20.09	17.41	17.21	16.44	15.09	39.90
1983	35.66	36.28	29.25	2.70	2.20	1.92	22.37	19.84	20.29	17.46	17.26	16.68	15.34	40.29
1984	35.75	36.27	29.93	2.82	2.33	2.08	22.58	20.05	20.50	17.51	17.31	16.92	15.59	40.69
1985	35.85	36.26	30.60	2.95	2.45	2.23	22.79	20.26	20.71	17.56	17.36	17.16	15.84	41.08
1986	35.97	36.27	31.30	3.07	2.58	2.33	23.09	20.56	21.01	17.87	17.68	17.34	16.02	41.23
1987	36.09	36.29	32.00	3.19	2.70	2.44	23.39	20.86	21.31	18.19	18.00	17.53	16.21	41.38
1988	36.21	36.31	32.70	3.32	2.82	2.54	23.69	21.16	21.61	18.51	18.31	17.71	16.39	41.53
1989	36.33	36.33	33.40	3.44	2.95	2.64	23.99	21.46	21.91	18.83	18.63	17.90	16.58	41.68
1990	36.45	36.44	34.10	3.56	3.07	2.74	24.29	21.76	22.21	19.15	18.95	18.09	16.76	41.83
1991	36.45	36.34	34.10	3.56	3.07	2.74	24.29	21.76	22.21	19.15	18.95	18.09	16.67	41.83

TABLE 5—ENERGY PRICES IN 1977 DOLLARS PER FUEL UNIT; FEA REGION V—MIDWEST

[Prices assumed constant from 1990 onward]

	Res. elect. $/MKWH	Comm. elect. $/MKWH	Ind. elect. $/MKWH	Res. N. gas $/MCFT	Comm. N. gas $/MCFT	Ind. N. gas $/MCFT	Res. dist. $/BBL	Comm. dist. $/BBL	Ind. dist. $/BBL	Comm. resid. $/BBL	Ind. resid. $/BBL	Res. LPG $/BBL	Ind. LPG $/BBL	Ind. coal $/MEST
1975	36.37	35.58	21.99	1.73	1.46	1.21	16.92	15.95	15.95	15.35	15.28	10.41	9.79	21.78
1976	36.61	35.90	22.83	1.85	1.57	1.31	17.32	16.35	16.34	15.99	15.91	11.10	10.48	24.30
1977	36.86	36.22	23.66	1.97	1.68	1.40	17.72	16.74	16.73	16.63	16.54	11.79	11.17	26.83
1978	37.11	36.53	24.49	2.09	1.79	1.49	18.12	17.13	17.11	17.28	17.16	12.47	11.86	29.35
1979	37.35	36.85	25.33	2.20	1.89	1.59	18.53	17.52	17.50	17.92	17.79	13.16	12.54	31.88
1980	37.60	37.17	26.16	2.32	2.00	1.68	18.93	17.91	17.89	18.56	18.41	13.85	13.23	34.40
1981	37.95	37.59	27.12	2.43	2.12	1.83	19.22	18.19	18.17	18.61	18.46	14.11	13.48	34.65
1982	38.31	38.02	28.09	2.54	2.24	1.97	19.50	18.48	18.46	18.65	18.51	14.36	13.73	34.90
1983	38.66	38.44	29.05	2.64	2.36	2.11	19.79	18.77	18.74	18.70	18.56	14.62	13.97	35.14
1984	39.01	38.87	30.01	2.75	2.48	2.25	20.07	19.05	19.03	18.75	18.61	14.87	14.22	35.39
1985	39.37	39.29	30.98	2.86	2.60	2.40	20.36	19.34	19.32	18.80	18.66	15.13	14.47	35.64
1986	39.63	39.63	31.85	3.04	2.78	2.54	20.66	19.64	19.62	19.13	18.99	15.31	14.65	35.89
1987	39.90	39.96	32.72	3.21	2.93	2.68	20.96	19.94	19.91	19.46	19.32	15.50	14.84	36.13
1988	40.16	40.30	33.59	3.38	3.09	2.82	21.26	20.24	20.21	19.79	19.65	15.69	15.02	36.38

TABLE 5—ENERGY PRICES IN 1977 DOLLARS PER FUEL UNIT; FEA REGION V—MIDWEST—Continued

[Prices assumed constant from 1990 onward]

	Res. elect. $/MKWH	Comm. elect. $/MKWH	Ind. elect. $/MKWH	Res. N. gas $/MCFT	Comm. N. gas $/MCFT	Ind. N. gas $/MCFT	Res. dist. $/BBL	Comm. dist. $/BBL	Ind. dist. $/BBL	Comm. resid. $/BBL	Ind. resid. $/BBL	Res. LPG $/BBL	Ind. LPG $/BBL	Ind. coal $/MEST
1989	40.42	40.63	34.46	3.56	3.26	2.96	21.56	20.53	20.51	20.12	19.98	15.87	15.21	36.83
1990	40.69	40.96	35.33	3.74	3.42	3.10	21.86	20.83	20.81	20.45	20.31	16.06	15.39	36.88
1991	40.69	40.96	35.33	3.74	3.42	3.10	21.86	20.83	20.81	20.45	20.31	16.06	15.39	36.88

TABLE 6—ENERGY PRICES IN 1977 DOLLARS PER FUEL UNIT; FEA REGION VI—SOUTHWEST

[Prices assumed constant from 1990 onward]

	Res. elect. $/MKWH	Comm. elect. $/MKWH	Ind. elect. $/MKWH	Res. N. gas $/MCFT	Comm. N. gas $/MCFT	Ind. N. gas $/MCFT	Res. dist. $/BBL	Comm. dist. $/BBL	Ind. dist. $/BBL	Comm. resid. $/BBL	Ind. resid. $/BBL	Res. LPG $/BBL	Ind. LPG $/BBL	Ind. coal $/MEST
1975	29.69	25.93	15.91	1.53	1.03	0.80	17.43	15.95	15.89	13.28	13.69	10.72	9.92	41.83
1976	33.13	29.56	19.99	1.60	1.14	1.05	17.94	16.48	16.41	14.12	14.44	11.42	10.62	39.75
1977	36.57	33.18	24.07	1.66	1.24	1.30	18.45	17.00	16.92	14.97	15.19	12.13	11.32	37.67
1978	40.00	36.80	28.15	1.73	1.34	1.54	18.96	17.52	17.44	15.81	15.94	12.84	12.02	35.59
1979	43.44	40.42	32.22	1.79	1.45	1.79	19.47	18.05	17.95	16.66	16.70	13.54	12.71	33.51
1980	46.88	44.04	36.30	1.86	1.55	2.03	19.98	18.57	18.47	17.50	17.45	14.25	13.41	31.43
1981	46.48	43.82	36.55	1.93	1.73	2.06	20.18	18.78	18.68	17.55	17.49	14.49	13.65	31.73
1982	46.06	43.60	36.80	2.00	1.91	2.09	20.39	18.99	18.89	17.60	17.54	14.72	13.89	32.03
1983	45.68	43.38	37.05	2.06	2.09	2.11	20.60	19.19	19.10	17.65	17.59	14.96	14.12	32.32
1984	45.26	43.16	37.29	2.13	2.27	2.14	20.81	19.40	19.30	17.69	17.64	15.20	14.36	32.62
1985	44.88	42.94	37.54	2.20	2.45	2.17	21.02	19.61	19.51	17.74	17.69	15.44	14.60	32.92
1986	45.27	43.52	38.58	2.34	2.67	2.38	21.32	19.91	19.81	18.07	18.01	15.62	14.79	33.41
1987	45.66	44.09	39.62	2.47	2.89	2.60	21.62	20.21	20.11	18.39	18.34	15.81	14.97	33.91
1988	46.05	44.66	40.66	2.61	3.11	2.82	21.92	20.51	20.41	18.72	18.66	15.99	15.16	34.40
1989	46.44	45.23	41.71	2.75	3.32	3.04	22.22	20.81	20.71	19.05	18.99	16.18	15.34	34.90
1990	46.83	45.80	42.75	2.88	3.54	3.26	22.52	21.11	21.01	19.37	19.32	16.36	15.53	35.39
1991	46.83	45.80	42.75	2.88	3.54	3.26	22.52	21.11	21.01	19.37	19.32	16.36	15.53	35.39

TABLE 7—ENERGY PRICES IN 1977 DOLLARS PER FUEL UNIT; FEA REGION VII—CENTRAL

[Prices assumed constant from 1990 onward]

	Res. elect. $/MKWH	Comm. elect. $/MKWH	Ind. elect. $/MKWH	Res. N. gas $/MCFT	Comm. N. gas $/MCFT	Ind. N. gas $/MCFT	Res. dist. $/BBL	Comm. dist. $/BBL	Ind. dist. $/BBL	Comm. resid. $/BBL	Ind. resid. $/BBL	Res. LPG $/BBL	Ind. LPG $/BBL	Ind. coal $/MEST
1975	33.40	31.00	21.28	1.46	1.10	0.76	17.11	16.02	15.95	16.60	16.39	10.50	9.79	28.46
1976	34.73	32.22	22.79	1.52	1.15	1.19	17.36	16.30	16.24	17.00	16.80	11.09	10.40	29.40
1977	36.05	33.44	24.30	1.57	1.21	1.63	17.61	16.57	16.52	17.40	17.21	11.68	11.01	30.34
1978	37.38	34.66	25.81	1.63	1.26	2.06	17.87	16.85	16.80	17.81	17.62	12.27	11.62	31.28
1979	38.70	35.88	27.32	1.68	1.31	2.49	18.12	17.13	17.08	18.21	18.03	12.86	12.23	32.22
1980	40.03	37.10	28.83	1.74	1.36	2.93	18.37	17.40	17.36	18.61	18.44	13.45	12.84	33.16
1981	39.92	37.41	29.59	1.79	1.80	2.98	18.66	17.69	17.64	18.66	18.48	13.70	13.09	33.36
1982	39.80	37.71	30.35	1.84	2.23	3.03	18.94	17.97	17.93	18.71	18.53	13.95	13.35	33.56
1983	39.69	38.01	31.11	1.90	2.66	3.08	19.23	18.26	18.22	18.76	18.58	14.19	13.60	33.76
1984	39.58	38.32	31.88	1.95	3.09	3.13	19.51	18.55	18.50	18.81	18.63	14.44	13.86	33.96
1985	39.47	38.62	32.64	2.00	3.52	3.18	19.80	18.83	18.79	18.85	18.68	14.69	14.12	34.15
1986	39.12	38.69	33.16	2.18	3.57	3.23	20.10	19.13	19.09	19.18	19.00	14.91	14.34	34.45
1987	38.77	38.76	33.68	2.36	3.61	3.27	20.40	19.43	19.39	19.51	19.33	15.13	14.56	34.75
1988	38.42	38.83	34.20	2.54	3.66	3.32	20.70	19.73	19.69	19.83	19.65	15.35	14.78	35.05
1989	38.07	38.89	34.72	2.72	3.70	3.36	21.00	20.03	19.98	20.16	19.98	15.57	15.00	35.34
1990	37.72	38.96	35.24	2.90	3.75	3.41	21.30	20.33	20.28	20.48	20.31	15.79	15.22	35.64
1991	37.72	38.96	35.24	2.90	3.75	3.41	21.30	20.33	20.28	20.48	20.31	15.79	15.22	35.64

TABLE 8—ENERGY PRICES IN 1977 DOLLARS PER FUEL UNIT; FEA REGION VIII—NORTH CENTRAL

[Prices assumed constant from 1990 onward]

	Res. elect. $/MKWH	Comm. elect. $/MKWH	Ind. elect. $/MKWH	Res. N. gas $/MCFT	Comm. N. gas $/MCFT	Ind. N. gas $/MCFT	Res. dist. $/BBL	Comm. dist. $/BBL	Ind. dist $/BBL	Comm. resid. $/BBL	Ind. resid. $/BBL	Res. LPG $/BBL	Ind. LPG. $/BBL	Ind. coal $/MEST
1975	30.78	25.86	13.96	1.38	1.11	0.68	17.94	17.17	17.17	17.63	17.29	11.51	10.72	20.54
1976	30.86	26.16	14.97	1.41	1.24	0.97	18.26	17.38	17.43	17.89	17.55	11.94	11.15	21.88
1977	30.94	26.46	15.98	1.50	1.37	1.26	18.57	17.60	17.69	18.14	17.81	12.38	11.58	23.22
1978	31.01	26.76	16.98	1.59	1.49	1.55	18.88	17.82	17.94	18.39	18.06	12.81	12.02	24.55
1979	31.09	27.07	17.99	1.67	1.62	1.84	19.20	18.03	18.20	18.65	18.32	13.24	12.45	25.89
1980	31.17	27.37	19.00	1.76	1.75	2.13	19.51	18.25	18.46	18.90	18.58	13.67	12.88	27.22
1981	31.08	27.50	19.85	1.81	1.97	2.18	19.78	18.52	18.73	18.97	18.65	13.92	13.13	27.42
1982	30.99	27.62	20.70	1.86	2.19	2.24	20.05	18.79	18.99	19.05	18.73	14.17	13.37	27.62
1983	30.90	27.75	21.54	1.91	2.41	2.29	20.32	19.05	19.26	19.12	18.80	14.42	13.62	27.82
1984	30.81	27.88	22.39	1.95	2.63	2.34	20.59	19.32	19.53	19.20	18.88	14.66	13.87	28.02
1985	30.72	28.01	23.24	2.00	2.85	2.39	20.86	19.59	19.80	19.27	18.95	14.91	14.12	28.21
1986	31.06	28.56	24.52	2.17	3.02	2.55	21.16	19.89	20.10	19.81	19.49	15.12	14.33	28.56
1987	31.40	29.11	25.79	2.34	3.18	2.72	21.45	20.19	20.40	20.35	20.03	15.33	14.54	28.91
1988	31.74	29.67	27.07	2.51	3.35	2.89	21.75	20.49	20.70	20.88	20.56	15.54	14.75	29.25

TABLE 8—ENERGY PRICES IN 1977 DOLLARS PER FUEL UNIT; FEA REGION VIII—NORTH CENTRAL—Continued

[Prices assumed constant from 1990 onward]

	Res. elect. S/ MKWH	Comm. elect. S/ MKWH	Ind. elect. S/MKWH	Res. N. gas S/ MCFT	Comm. N. gas S/ MCFT	Ind. N. gas S/ MCFT	Res. dist. S/BBL	Comm. dist. S/ BBL	Ind. dist. S/BBL	Comm. resid. S/ BBL	Ind. resid. S/BBL	Res. LPG S/BBL	Ind. LPG S/BBL	Ind. coal S/MEST
1989	32.08	30.22	28.35	2.88	3.52	3.08	22.05	20.79	21.00	21.42	21.10	15.76	14.96	29.80
1990	32.42	30.78	29.62	2.85	3.68	3.22	22.35	21.09	21.30	21.96	21.64	15.97	15.17	29.95
1991	32.42	30.78	29.62	2.85	3.68	3.22	22.35	21.09	21.30	21.96	21.64	15.97	15.17	29.95

TABLE 9—ENERGY PRICES IN 1977 DOLLARS PER FUEL UNIT; FEA REGION IX—WESTERN

[Prices assumed constant from 1990 onward]

	Res. elect. S/ MKWH	Comm. elect. S/ MKWH	Ind. elect. S/MKWH	Res. N. gas S/ MCFT	Comm. N. gas S/ MCFT	Ind. N. gas S/ MCFT	Res. dist. S/BBL	Comm. dist. S/ BBL	Ind. dist. S/BBL	Comm. resid. S/ BBL	Ind. resid. S/BBL	Res. LPG S/BBL	Ind. LPG S/BBL	Ind. coal S/MEST
1975	36.97	31.11	23.76	1.73	1.42	1.12	19.16	17.56	17.56	18.26	18.19	12.31	11.29	41.33
1976	38.87	33.30	26.10	1.89	1.54	1.53	19.30	17.71	17.71	18.12	18.06	12.67	11.67	39.90
1977	40.77	35.48	28.45	2.06	1.66	1.94	19.45	17.87	17.87	17.99	17.94	13.03	12.05	38.46
1978	42.67	37.66	30.79	2.22	1.79	2.36	19.59	18.03	18.03	17.86	17.82	13.39	12.43	37.03
1979	44.56	39.84	33.14	2.38	1.91	2.77	19.73	18.19	18.19	17.72	17.69	13.75	12.81	35.59
1980	46.46	42.02	35.49	2.54	2.03	3.18	19.88	18.35	18.35	17.59	17.57	14.12	13.19	34.15
1981	46.06	41.90	35.56	2.79	2.28	3.06	20.09	18.57	18.57	17.63	17.61	14.35	13.43	34.50
1982	45.66	41.76	35.64	3.04	2.53	2.95	20.31	18.78	18.78	17.67	17.65	14.59	13.67	34.85
1983	45.26	41.66	35.71	3.29	2.78	2.83	20.53	19.00	19.00	17.71	17.69	14.83	13.90	35.19
1984	44.86	41.54	35.79	3.54	3.03	2.71	20.75	19.22	19.22	17.75	17.73	15.07	14.14	35.54
1985	44.46	41.43	35.86	3.78	3.28	2.60	20.97	19.44	19.44	17.79	17.76	15.31	14.38	35.89
1986	44.47	41.71	36.34	3.72	3.22	2.71	21.30	19.77	19.77	18.11	18.08	15.54	14.61	36.38
1987	44.47	42.00	36.81	3.66	3.15	2.83	21.63	20.10	20.10	18.42	18.40	15.76	14.84	36.88
1988	44.48	42.29	37.29	3.60	3.09	2.95	21.96	20.43	20.43	18.74	18.72	15.99	15.07	37.37
1989	44.48	42.58	37.77	3.54	3.03	3.06	22.29	20.76	20.76	19.06	19.04	16.22	15.30	37.87
1990	44.48	42.87	38.25	3.48	2.97	3.18	22.62	21.09	21.09	19.38	19.36	16.45	15.53	38.36
1991	44.48	42.87	38.25	3.48	2.97	3.18	22.62	21.09	21.09	19.38	19.36	16.45	15.53	38.36

TABLE 10—ENERGY PRICES IN 1977 DOLLARS PER FUEL UNIT; FEA REGION X—NORTHWESTERN

[Prices assumed constant from 1990 onward]

	Res. elect. $/MKWH	Comm. elect. $/MKWH	Ind. elect. $/MKWH	Res. N. gas $/MCFT	Comm. N. gas $/MCFT	Ind. N. gas $/MCFT	Res. dist. $/BBL	Comm. dist. $/BBL	Ind. dist. $/BBL	Comm. resid. $/BBL	Ind. resid. $/BBL	Res. LPG $/BBL	Ind. LPG $/BBL	Ind. coal $/MEST
1975	15.91	16.66	6.16	2.37	1.17	1.78	18.77	17.17	17.11	17.77	17.91	11.91	10.98	24.01
1976	17.27	17.93	7.85	2.59	2.00	1.38	18.99	17.41	17.36	17.65	17.91	12.35	11.42	24.55
1977	18.62	19.20	9.55	2.80	2.22	1.59	19.22	17.64	17.60	17.53	17.91	12.79	11.87	25.10
1978	19.97	20.47	11.24	3.02	2.44	1.80	19.44	17.88	17.85	17.41	17.90	13.23	12.31	25.64
1979	21.32	21.74	12.94	3.24	2.66	2.01	19.66	18.11	18.10	17.29	17.90	13.67	12.75	26.19
1980	22.67	23.01	14.63	3.45	2.88	2.22	19.88	18.35	18.35	17.17	17.90	14.12	13.19	26.73
1981	22.62	22.87	14.92	3.46	2.89	2.23	20.09	18.57	18.57	17.21	17.94	14.35	13.43	28.56
1982	22.56	22.73	15.22	3.46	2.89	2.23	20.31	18.78	18.78	17.25	17.98	14.59	13.67	30.39
1983	22.51	22.60	15.51	3.47	2.90	2.24	20.53	19.00	19.00	17.29	18.02	14.83	13.90	32.22
1984	22.45	22.46	15.80	3.47	2.90	2.24	20.75	19.22	19.22	17.33	18.06	15.07	14.14	34.06
1985	22.40	22.32	16.09	3.48	2.90	2.24	20.97	19.44	19.44	17.37	18.09	15.31	14.38	35.89
1986	22.76	22.60	16.80	3.41	3.22	2.56	21.30	19.77	19.77	17.69	18.41	15.54	14.61	36.93
1987	23.12	22.88	17.51	3.34	3.54	2.88	21.63	20.10	20.10	18.01	18.73	15.76	14.84	37.97
1988	23.48	23.16	18.22	3.26	3.86	3.20	21.96	20.43	20.43	18.33	19.05	15.99	15.07	39.01
1989	23.84	23.45	18.94	3.19	4.18	3.52	22.29	20.76	20.76	18.64	19.37	16.22	15.30	40.05
1990	24.20	23.73	19.65	3.12	4.50	3.84	22.62	21.09	21.09	18.96	19.69	16.45	15.53	41.08
1991	24.20	23.73	19.65	3.12	4.50	3.84	22.62	21.09	21.09	18.96	19.69	16.45	15.53	41.08

TABLE 11—ENERGY PRICES IN 1977 DOLLARS PER MILLION BTUS; FEA REGION I—NEW ENGLAND

[Prices assumed constant from 1990 onward]

	Res. elect.	Comm. elect.	Ind. elect.	Res. N. gas	Comm. N. gas	Ind. N. gas	Res. dist.	Comm. dist.	Ind. dist.	Comm. resid.	Ind. resid.	Res. LPG	Ind. LPG	Ind. coal
1975	14.53	14.15	10.35	3.37	2.79	2.36	3.44	3.05	3.05	2.33	2.34	3.89	3.32	1.26
1976	14.49	14.13	10.50	3.38	2.80	2.49	3.44	3.08	3.08	2.41	2.43	3.84	3.34	1.37
1977	14.44	14.12	10.65	3.40	2.81	2.61	3.44	3.11	3.11	2.49	2.52	3.79	3.36	1.47
1978	14.40	14.11	10.80	3.42	2.82	2.73	3.44	3.14	3.14	2.57	2.61	3.74	3.37	1.57
1979	14.35	14.09	10.95	3.44	2.82	2.86	3.44	3.18	3.18	2.65	2.69	3.68	3.39	1.67
1980	14.31	14.08	11.10	3.46	2.83	2.98	3.44	3.21	3.21	2.73	2.78	3.63	3.41	1.77
1981	14.29	14.09	11.28	3.61	2.98	3.00	3.47	3.24	3.24	2.74	2.79	3.68	3.46	1.79
1982	14.27	14.09	11.46	3.77	3.14	3.01	3.50	3.28	3.27	2.74	2.79	3.73	3.51	1.80
1983	14.24	14.10	11.65	3.92	3.29	3.03	3.54	3.31	3.31	2.75	2.80	3.78	3.56	1.82
1984	14.22	14.10	11.83	4.08	3.45	3.05	3.57	3.34	3.34	2.75	2.81	3.82	3.60	1.83
1985	14.20	14.11	12.01	4.23	3.60	3.07	3.60	3.37	3.37	2.76	2.81	3.87	3.65	1.85
1986	14.32	14.27	12.34	4.39	3.76	3.23	3.65	3.43	3.42	2.81	2.86	3.92	3.70	1.86
1987	14.45	14.42	12.67	4.55	3.92	3.39	3.71	3.48	3.48	2.86	2.91	3.98	3.75	1.87
1988	14.58	14.58	13.00	4.71	4.08	3.55	3.76	3.53	3.53	2.91	2.97	4.03	3.80	1.87
1989	14.70	14.73	13.33	4.87	4.24	3.71	3.81	3.58	3.58	2.96	3.02	4.08	3.85	1.88

TABLE 11—ENERGY PRICES IN 1977 DOLLARS PER MILLION BTUS; FEA REGION I—NEW ENGLAND—Continued

[Prices assumed constant from 1990 onward]

	Res. elect.	Comm. elect.	Ind. elect.	Res. N. gas	Comm. N. gas	Ind. N. gas	Res. dist.	Comm. dist.	Ind. dist.	Comm. resid.	Ind. resid.	Res. LPG	Ind. LPG	Ind. coal
1990	14.83	14.89	13.66	5.03	4.40	3.87	3.86	3.63	3.63	3.01	3.07	4.14	3.90	1.89
1991	14.83	14.89	13.66	5.03	4.40	3.87	3.86	3.63	3.63	3.01	3.07	4.14	3.90	1.89

TABLE 12—ENERGY PRICES IN 1977 DOLLARS PER MILLION BTUS; FEA REGION II—NEW YORK/NEW JERSEY

[Prices assumed constant from 1990 onward]

	Res. elect.	Comm. elect.	Ind. elect.	Res. N. gas	Comm. N. gas	Ind. N. gas	Res. dist.	Comm. dist.	Ind. dist.	Comm. resid.	Ind. resid.	Res. LPG	Ind. LPG	Ind. coal
1975	16.32	16.41	8.89	2.75	2.23	1.66	3.13	2.85	2.84	2.28	2.28	3.22	2.90	1.06
1976	16.15	16.40	8.85	2.84	2.31	1.72	3.21	2.93	2.92	2.39	2.40	3.31	3.01	1.18
1977	15.98	16.39	8.82	2.93	2.39	1.79	3.28	3.01	3.00	2.49	2.53	3.40	3.11	1.30
1978	15.81	16.37	8.79	3.02	2.47	1.85	3.35	3.09	3.07	2.60	2.66	3.49	3.21	1.42
1979	15.64	16.36	8.75	3.10	2.55	1.91	3.42	3.17	3.15	2.71	2.79	3.58	3.32	1.54
1980	15.47	16.35	8.72	3.19	2.63	1.98	3.49	3.25	3.23	2.82	2.91	3.67	3.42	1.66
1981	15.34	16.37	8.73	3.33	2.76	2.11	3.53	3.29	3.27	2.82	2.92	3.73	3.48	1.68
1982	15.20	16.39	8.74	3.46	2.89	2.24	3.56	3.32	3.31	2.83	2.93	3.78	3.53	1.69
1983	15.07	16.42	8.76	3.59	3.02	2.37	3.60	3.36	3.35	2.84	2.93	3.84	3.59	1.71
1984	14.93	16.44	8.77	3.72	3.16	2.51	3.64	3.40	3.38	2.84	2.94	3.89	3.64	1.72
1985	14.79	16.46	8.78	3.86	3.29	2.64	3.68	3.44	3.42	2.85	2.95	3.95	3.70	1.74
1986	14.82	16.64	8.95	3.97	3.40	2.75	3.73	3.49	3.47	2.90	3.00	4.00	3.75	1.75
1987	14.84	16.82	9.12	4.09	3.52	2.87	3.78	3.54	3.52	2.95	3.05	4.05	3.80	1.76
1988	14.86	17.00	9.29	4.20	3.64	2.98	3.83	3.59	3.57	3.00	3.10	4.11	3.85	1.76
1989	14.89	17.19	9.47	4.32	3.75	3.10	3.88	3.64	3.63	3.05	3.15	4.16	3.91	1.77
1990	14.91	17.37	9.64	4.43	3.87	3.21	3.93	3.69	3.68	3.10	3.20	4.21	3.96	1.78
1991	14.91	17.37	9.64	4.43	3.87	3.21	3.93	3.69	3.68	3.10	3.20	4.21	3.96	1.78

TABLE 13—ENERGY PRICES IN 1977 DOLLARS PER MILLION BTUS; FEA REGION III—MID-ATLANTIC

[Prices assumed constant from 1990 onward]

	Res. elect.	Comm. elect.	Ind. elect.	Res. N. gas	Comm N. gas	Ind. N. gas	Res. dist.	Comm. dist.	Ind. dist.	Comm. resid.	Ind. resid.	Res. LPG	Ind. LPG	Ind. coal
1975	12.24	11.38	8.02	2.12	1.81	1.19	3.06	2.84	2.82	2.27	2.23	2.90	2.74	0.81
1976	12.18	11.35	8.10	2.25	1.91	1.39	3.18	2.93	2.93	2.43	2.39	3.12	2.91	0.96
1977	12.12	11.32	8.19	2.37	2.01	1.58	3.30	3.02	3.04	2.60	2.56	3.33	3.08	1.11
1978	12.06	11.29	8.27	2.50	2.11	1.76	3.42	3.11	3.16	2.77	2.71	3.54	3.26	1.26

1980	11.94	11.23	8.44	2.74	2.31	2.18	3.67	3.30	[illegible]	3.11	[illegible]	[illegible]	3.61	[illegible]
1981	12.01	11.34	8.67	2.86	2.43	2.24	3.70	3.33	3.42	3.11	3.04	4.02	3.67	1.56
1982	12.08	11.44	8.89	2.98	2.55	2.31	3.74	3.37	3.46	3.12	3.04	4.07	3.72	1.58
1983	12.15	11.55	9.12	3.10	2.67	2.38	3.77	3.40	3.49	3.12	3.05	4.13	3.78	1.61
1984	12.23	11.65	9.35	3.22	2.79	2.44	3.81	3.44	3.53	3.13	3.06	4.19	3.84	1.63
1985	12.30	11.76	9.58	3.34	2.90	2.51	3.84	3.47	3.57	3.14	3.06	4.25	3.89	1.64
1986	12.40	11.89	9.83	3.43	3.00	2.60	3.90	3.53	3.62	3.19	3.11	4.30	3.94	1.65
1987	12.49	12.02	10.08	3.53	3.09	2.70	3.95	3.58	3.67	3.24	3.16	4.35	4.00	1.65
1988	12.59	12.14	10.33	3.62	3.18	2.79	4.00	3.63	3.72	3.29	3.21	4.40	4.05	1.66
1989	12.69	12.27	10.58	3.71	3.27	2.89	4.05	3.68	3.77	3.34	3.26	4.45	4.10	1.67
1990	12.79	12.40	10.83	3.80	3.36	2.98	4.10	3.73	3.82	3.39	3.32	4.50	4.15	1.67
1991	12.79	12.40	10.83	3.80	3.36	2.98	4.10	3.73	3.82	3.39	3.32	4.50	4.15	167

TABLE 14—ENERGY PRICES IN 1977 DOLLARS PER MILLION BTUS; FEA REGION IV—SOUTH ATLANTIC

[Prices assumed constant from 1990 onward]

	Res. elect.	Comm. elect.	Ind. elect.	Res. N. gas	Comm. N. gas	Ind. N. gas	Res. dist.	Comm. dist.	Ind. dist.	Comm. resid.	Ind. resid.	Res. LPG	Ind. LPG	Ind. coal
1975	9.01	9.44	5.81	1.64	1.30	0.91	3.08	2.84	2.82	2.02	2.05	2.74	2.53	0.97
1976	9.28	9.68	6.24	1.76	1.39	1.01	3.21	2.93	2.93	2.17	2.18	2.99	2.75	1.12
1977	9.55	9.92	6.68	1.88	1.49	1.11	3.34	3.02	3.04	2.32	2.32	3.24	2.97	1.28
1978	9.82	10.16	7.11	2.01	1.58	1.21	3.47	3.11	3.15	2.46	2.45	3.48	3.20	1.43
1979	10.09	10.40	7.54	2.13	1.68	1.31	3.60	3.21	3.26	2.61	2.59	3.73	3.42	1.58
1980	10.36	10.64	7.98	2.25	1.77	1.41	3.73	3.30	3.36	2.75	2.72	3.98	3.64	1.74
1981	10.39	10.64	8.18	2.38	1.89	1.56	3.77	3.33	3.41	2.76	2.73	4.04	3.70	1.76
1982	10.42	10.64	8.38	2.50	2.02	1.71	3.81	3.37	3.45	2.77	2.74	4.10	3.76	1.77
1983	10.45	10.63	8.57	2.62	2.14	1.86	3.84	3.41	3.48	2.78	2.75	4.16	3.83	1.79
1984	10.48	10.63	8.77	2.74	2.26	2.02	3.88	3.44	3.52	2.78	2.75	4.22	3.89	1.81
1985	10.51	10.63	8.97	2.86	2.38	2.17	3.91	3.48	3.56	2.79	2.76	4.28	3.95	1.83
1986	10.54	10.63	9.17	2.98	2.50	2.27	3.96	3.53	3.61	2.84	2.81	4.33	4.00	1.83
1987	10.58	10.64	9.38	3.10	2.62	2.36	4.02	3.58	3.66	2.89	2.86	4.37	4.04	1.84
1988	10.61	10.64	9.58	3.22	2.74	2.46	4.07	3.63	3.71	2.94	2.91	4.42	4.09	1.85
1989	10.65	10.65	9.79	3.34	2.86	2.56	4.12	3.68	3.76	3.00	2.96	4.46	4.13	1.85
1990	10.68	10.65	9.99	3.46	2.98	2.66	4.17	3.74	3.81	3.05	3.01	4.51	4.18	1.86
1991	10.68	10.65	9.99	3.46	2.98	2.66	4.17	3.74	3.81	3.05	3.01	4.51	4.18	1.86

TABLE 15—ENERGY PRICES IN 1977 DOLLARS PER MILLION BTUS; FEA REGION V—MIDWEST

[Prices assumed constant from 1990 onward]

	Res. elect.	Comm. elect.	Ind. elect.	Res. N. gas	Comm. N. gas	Ind. N. gas	Res. dist.	Comm. dist.	Ind. dist.	Comm. resid.	Ind. resid	Res. LPG	Ind. LPG	Ind. coal
1975	10.66	10.43	6.45	1.68	1.42	1.18	2.90	2.74	2.74	2.44	2.43	2.60	2.44	0.97
1976	10.73	10.52	6.69	1.80	1.52	1.27	2.97	2.81	2.81	2.54	2.53	2.77	2.61	1.08

TABLE 15—ENERGY PRICES IN 1977 DOLLARS PER MILLION BTUS; FEA REGION V—MIDWEST—Continued

[Prices assumed constant from 1990 onward]

	Res. elect.	Comm. elect.	Ind. elect.	Res. N. gas	Comm. N. gas	Ind. N. gas	Res. dist.	Comm. dist.	Ind. dist.	Comm. resid.	Ind. resid.	Res. LPG	Ind. LPG	Ind. coal
1977	10.80	10.61	6.93	1.91	1.63	1.36	3.04	2.87	2.87	2.65	2.63	2.94	2.79	1.19
1978	10.88	10.71	7.18	2.03	1.73	1.45	3.11	2.94	2.94	2.75	2.73	3.11	2.96	1.30
1979	10.95	10.80	7.42	2.14	1.84	1.54	3.18	3.01	3.00	2.85	2.83	3.28	3.13	1.42
1980	11.02	10.89	7.67	2.25	1.94	1.63	3.25	3.07	3.07	2.95	2.93	3.45	3.30	1.53
1981	11.12	11.02	7.95	2.36	2.06	1.77	3.30	3.12	3.12	2.96	2.94	3.52	3.36	1.54
1982	11.23	11.14	8.23	2.46	2.17	1.91	3.35	3.17	3.17	2.97	2.94	3.58	3.42	1.55
1983	11.33	11.27	8.51	2.57	2.29	2.05	3.40	3.22	3.22	2.97	2.95	3.65	3.48	1.56
1984	11.43	11.39	8.80	2.67	2.41	2.19	3.45	3.27	3.27	2.98	2.96	3.71	3.55	1.57
1985	11.54	11.52	9.08	2.78	2.52	2.33	3.50	3.32	3.32	2.99	2.97	3.77	3.61	1.58
1986	11.62	11.61	9.33	2.95	2.68	2.48	3.55	3.37	3.37	3.04	3.02	3.82	3.65	1.59
1987	11.69	11.71	9.59	3.12	2.84	2.60	3.60	3.42	3.42	3.10	3.07	3.87	3.70	1.61
1988	11.77	11.81	9.84	3.29	3.00	2.74	3.65	3.47	3.47	3.15	3.12	3.91	3.75	1.62
1989	11.85	11.91	10.10	3.46	3.16	2.87	3.70	3.53	3.52	3.20	3.18	3.96	3.79	1.63
1990	11.93	12.01	10.36	3.63	3.32	3.01	3.75	3.58	3.57	3.25	3.23	4.00	3.84	1.64
1991	11.93	12.01	10.36	3.63	3.32	3.01	3.75	3.58	3.57	3.25	3.23	4.00	3.84	1.64

TABLE 16—ENERGY PRICES IN 1977 DOLLARS PER MILLION BTUS; FEA REGION VI—SOUTHWEST

[Prices assumed constant from 1990 onward]

	Res. elect.	Comm. elect.	Ind. elect.	Res. N. gas	Comm. N. gas	Ind. N. gas	Res. dist.	Comm. dist.	Ind. dist.	Comm. resid.	Ind. resid.	Res. LPG	Ind. LPG	Ind. coal
1975	8.70	7.60	4.66	1.48	1.00	0.78	2.99	2.74	2.73	2.11	2.18	2.67	2.47	1.86
1976	9.71	8.66	5.86	1.55	1.10	1.02	3.08	2.83	2.82	2.25	2.30	2.85	2.65	1.77
1977	10.72	9.72	7.05	1.61	1.20	1.26	3.17	2.92	2.91	2.38	2.42	3.02	2.82	1.67
1978	11.72	10.79	8.25	1.66	1.30	1.50	3.25	3.01	2.99	2.52	2.54	3.20	3.00	1.58
1979	12.73	11.85	9.44	1.74	1.40	1.74	3.34	3.10	3.08	2.65	2.66	3.38	3.17	1.49
1980	13.74	12.91	10.64	1.80	1.51	1.98	3.43	3.19	3.17	2.76	2.77	3.55	3.34	1.40
1981	13.62	12.84	10.71	1.87	1.68	2.00	3.47	3.22	3.21	2.79	2.78	3.61	3.40	1.41
1982	13.51	12.78	10.78	1.94	1.86	2.03	3.50	3.26	3.24	2.80	2.79	3.67	3.46	1.42
1983	13.39	12.72	10.86	2.00	2.03	2.05	3.54	3.30	3.28	2.81	2.80	3.73	3.52	1.44
1984	13.27	12.65	10.93	2.07	2.21	2.08	3.57	3.33	3.31	2.81	2.81	3.79	3.58	1.45
1985	13.15	12.59	11.00	2.14	2.38	2.10	3.61	3.37	3.35	2.82	2.81	3.85	3.64	1.46
1986	13.27	12.75	11.31	2.27	2.59	2.32	3.66	3.42	3.40	2.87	2.87	3.90	3.69	1.48
1987	13.38	12.92	11.61	2.40	2.80	2.53	3.71	3.47	3.45	2.93	2.92	3.94	3.73	1.51
1988	13.50	13.09	11.92	2.53	3.02	2.74	3.76	3.52	3.50	2.98	2.97	3.99	3.78	1.53
1989	13.61	13.26	12.22	2.67	3.23	2.95	3.81	3.57	3.56	3.03	3.02	4.03	3.83	1.55
1990	13.72	13.42	12.53	2.80	3.44	3.16	3.87	3.62	3.61	3.08	3.07	4.08	3.87	1.57
1991	13.72	13.42	12.53	2.80	3.44	3.16	3.87	3.62	3.61	3.08	3.07	4.08	3.87	1.57

TABLE 17—ENERGY PRICES IN 1977 DOLLARS PER MILLION BTUS; FEA REGION VII—CENTRAL

[Prices assumed constant from 1990 onward]

	Res. elect.	Comm. elect.	Ind. elect.	Res. N. gas	Comm. N. gas	Ind. N. gas	Res. dist.	Comm. dist.	Ind. dist.	Comm. resid.	Ind. resid.	Res. LPG	Ind. LPG	Ind. coal
1975	9.79	9.09	6.24	1.42	1.07	0.74	2.94	2.75	2.74	2.64	2.61	2.62	2.44	1.26
1976	10.18	9.44	6.68	1.47	1.12	1.16	2.98	2.80	2.79	2.70	2.67	2.77	2.59	1.31
1977	10.57	9.80	7.12	1.53	1.17	1.58	3.02	2.84	2.84	2.77	2.74	2.91	2.75	1.35
1978	10.96	10.16	7.56	1.58	1.22	2.00	3.07	2.89	2.88	2.83	2.80	3.06	2.90	1.39
1979	11.34	10.52	8.01	1.63	1.27	2.42	3.11	2.94	2.93	2.90	2.87	3.21	3.05	1.43
1980	11.73	10.87	8.45	1.69	1.32	2.84	3.15	2.99	2.98	2.96	2.93	3.35	3.20	1.47
1981	11.70	10.96	8.67	1.74	1.74	2.89	3.20	3.04	3.03	2.97	2.94	3.42	3.26	1.48
1982	11.67	11.05	8.90	1.79	2.16	2.94	3.25	3.09	3.08	2.98	2.95	3.48	3.33	1.49
1983	11.63	11.14	9.12	1.84	2.58	2.99	3.30	3.13	3.13	2.98	2.96	3.54	3.39	1.50
1984	11.60	11.23	9.34	1.89	3.00	3.04	3.35	3.18	3.18	2.99	2.96	3.60	3.46	1.51
1985	11.57	11.32	9.57	1.94	3.42	3.09	3.40	3.23	3.23	3.00	2.97	3.66	3.52	1.52
1986	11.46	11.34	9.72	2.12	3.46	3.13	3.45	3.28	3.28	3.05	3.02	3.72	3.57	1.53
1987	11.36	11.36	9.87	2.29	3.51	3.18	3.50	3.34	3.33	3.10	3.07	3.77	3.63	1.54
1988	11.26	11.38	10.02	2.47	3.55	3.22	3.55	3.39	3.38	3.15	3.13	3.83	3.68	1.56
1989	11.16	11.40	10.18	2.64	3.60	3.27	3.60	3.44	3.43	3.21	3.18	3.88	3.74	1.57
1990	11.05	11.42	10.33	2.82	3.64	3.31	3.66	3.49	3.48	3.26	3.23	3.94	3.79	1.58
1991	11.05	11.42	10.33	2.82	3.64	3.31	3.66	3.49	3.48	3.26	3.23	3.94	3.79	1.58

TABLE 18—ENERGY PRICES IN 1977 DOLLARS PER MILLION BTUS; FEA REGION VIII—NORTH CENTRAL

[Prices assumed constant from 1990 onward]

	Res. elect.	Comm. elect.	Ind. elect.	Res. N. gas	Comm. N. gas	Ind. N. gas	Res. dist.	Comm. dist.	Ind. dist.	Comm. resid.	Ind. resid.	Res. LPG	Ind. LPG	Ind. coal
1975	9.02	7.58	4.09	1.29	1.08	0.66	3.08	2.95	2.95	2.80	2.75	2.87	2.67	0.91
1976	9.04	7.67	4.39	1.37	1.20	0.94	3.13	2.95	2.98	2.85	2.79	2.98	2.78	0.97
1977	9.07	7.76	4.68	1.48	1.33	1.22	3.19	3.02	3.04	2.89	2.83	3.09	2.89	1.03
1978	9.09	7.84	4.98	1.54	1.45	1.51	3.24	3.06	3.08	2.93	2.87	3.19	3.00	1.09
1979	9.11	7.93	5.27	1.62	1.57	1.79	3.30	3.10	3.12	2.97	2.91	3.30	3.10	1.15
1980	9.14	8.02	5.57	1.71	1.70	2.07	3.35	3.13	3.17	3.01	2.96	3.41	3.21	1.21
1981	9.11	8.06	5.82	1.76	1.91	2.12	3.40	3.18	3.21	3.02	2.97	3.47	3.27	1.22
1982	9.08	8.10	6.07	1.80	2.13	2.17	3.44	3.23	3.26	3.03	2.98	3.53	3.34	1.23
1983	9.06	8.13	6.31	1.85	2.34	2.22	3.49	3.27	3.31	3.04	2.99	3.59	3.40	1.24
1984	9.03	8.17	6.56	1.90	2.55	2.27	3.53	3.32	3.35	3.05	3.00	3.66	3.46	1.25
1985	9.00	8.21	6.81	1.94	2.77	2.32	3.58	3.36	3.40	3.07	3.01	3.72	3.52	1.25
1986	9.10	8.37	7.19	2.11	2.93	2.48	3.63	3.41	3.45	3.15	3.10	3.77	3.57	1.27
1987	9.20	8.53	7.56	2.27	3.09	2.64	3.68	3.47	3.50	3.24	3.19	3.82	3.63	1.28
1988	9.30	8.70	7.93	2.44	3.25	2.80	3.73	3.52	3.55	3.32	3.27	3.88	3.68	1.30
1989	9.40	8.86	8.31	2.60	3.42	2.97	3.79	3.57	3.60	3.41	3.36	3.93	3.73	1.32
1990	9.50	9.02	8.68	2.77	3.58	3.13	3.84	3.62	3.66	3.49	3.44	3.98	3.78	1.33

TABLE 18—ENERGY PRICES IN 1977 DOLLARS PER MILLION BTUS; FEA REGION VIII—NORTH CENTRAL—Continued

[Prices assumed constant from 1990 onward]

	Res. elect.	Comm. elect.	Ind. elect.	Res. N. gas	Comm. N. gas	Ind. N. gas	Res. dist.	Comm. dist.	Ind. dist.	Comm. resid.	Ind. resid.	Res. LPG	Ind. LPG	Ind. coal
1991	9.50	9.02	8.88	2.77	3.58	3.13	3.84	3.62	3.86	3.49	3.44	3.98	3.78	1.33

TABLE 19—ENERGY PRICES IN 1977 DOLLARS PER MILLION BTUS; FEA REGION IX—WESTERN

[Prices assumed constant from 1990 onward]

	Res. elect.	Comm. elect.	Ind. elect.	Res. N. gas	Comm. N. gas	Ind. N. gas	Res. dist.	Comm. dist.	Ind. dist.	Comm. resid.	Ind. resid.	Res. LPG	Ind. LPG	Ind. coal
1975	10.83	9.12	6.96	1.68	1.37	1.09	3.29	3.01	3.01	2.90	2.89	3.07	2.82	1.84
1976	11.39	9.76	7.65	1.84	1.50	1.49	3.31	3.04	3.04	2.88	2.87	3.16	2.91	1.77
1977	11.95	10.40	8.34	2.00	1.62	1.89	3.34	3.07	3.07	2.86	2.85	3.25	3.01	1.71
1978	12.50	11.04	9.03	2.15	1.74	2.29	3.36	3.10	3.10	2.84	2.83	3.34	3.10	1.65
1979	13.06	11.68	9.71	2.31	1.86	2.69	3.39	3.12	3.12	2.82	2.81	3.43	3.19	1.58
1980	13.62	12.32	10.40	2.47	1.98	3.09	3.41	3.15	3.15	2.80	2.79	3.52	3.29	1.52
1981	13.50	12.28	10.42	2.71	2.22	2.97	3.45	3.19	3.19	2.80	2.80	3.58	3.35	1.53
1982	13.38	12.25	10.44	2.95	2.46	2.86	3.49	3.22	3.22	2.81	2.81	3.64	3.41	1.55
1983	13.27	12.21	10.47	3.19	2.70	2.75	3.52	3.26	3.26	2.82	2.81	3.70	3.47	1.56
1984	13.15	12.18	10.49	3.43	2.94	2.63	3.56	3.30	3.30	2.82	2.82	3.76	3.53	1.58
1985	13.03	12.14	10.51	3.67	3.18	2.52	3.60	3.34	3.34	2.83	2.83	3.82	3.59	1.59
1986	13.00	12.23	10.65	3.61	3.12	2.63	3.66	3.39	3.39	2.88	2.88	3.87	3.64	1.62
1987	13.03	12.31	10.79	3.55	3.06	2.75	3.71	3.45	3.45	2.93	2.93	3.93	3.70	1.64
1988	13.03	12.31	10.93	3.49	3.00	2.86	3.77	3.51	3.51	2.98	2.98	3.99	3.76	1.66
1989	13.04	12.48	11.07	3.43	2.94	2.97	3.83	3.56	3.56	3.03	3.03	4.05	3.81	1.68
1990	13.04	12.56	11.21	3.37	2.88	3.09	3.88	3.62	3.62	3.08	3.08	4.10	3.87	1.70
1991	13.04	12.56	11.21	3.37	2.88	3.09	3.88	3.62	3.62	3.08	3.08	4.10	3.87	1.70

TABLE 20—ENERGY PRICES IN 1977 DOLLARS PER MILLION BTUS; FEA REGION X—NORTHWESTERN

[Prices assumed constant from 1990 onward]

	Res. elect.	Comm. elect.	Ind. elect.	Res. N. gas	Comm. N. gas	Ind. N. gas	Res. dist.	Comm. dist.	Ind. dist.	Comm. resid.	Ind. resid.	Res. LPG	Ind. LPG	Ind. coal
1975	4.66	4.66	1.80	2.30	1.73	1.13	3.22	2.95	2.94	2.83	2.85	2.87	2.74	1.07
1976	5.06	5.26	2.30	2.51	1.94	1.34	3.26	2.99	2.98	2.81	2.85	3.06	2.85	1.09
1977	5.46	5.63	2.80	2.72	2.16	1.64	3.30	3.03	3.02	2.79	2.86	3.19	2.96	1.12
1978	5.86	6.00	3.29	2.93	2.37	1.78	3.34	3.07	3.06	2.77	2.85	3.30	3.07	1.14
1979	6.25	6.37	3.79	3.14	2.58	1.95	3.37	3.11	3.11	2.75	2.86	3.41	3.19	1.16
[illegible]	[illegible]	6.74	[illegible]	[illegible]	[illegible]	[illegible]	3.41	3.16	[illegible]	2.73	[illegible]	[illegible]	[illegible]	1.19

1981	6.63	6.70	4.37	3.36	2.80	2.16	3.45	3.19	3.19	2.74	2.85	3.58	3.35	1.27
1982	6.61	6.66	4.46	3.36	2.81	2.17	3.49	3.22	3.22	2.74	2.86	3.64	3.41	1.35
1983	6.60	6.62	4.55	3.37	2.81	2.17	3.52	3.26	3.26	2.75	2.87	3.70	3.47	1.43
1984	6.58	6.58	4.63	3.37	2.82	2.17	3.56	3.30	3.30	2.76	2.87	3.76	3.53	1.51
1985	6.56	6.54	4.72	3.37	2.82	2.18	3.60	3.34	3.34	2.78	2.88	3.82	3.59	1.59
1986	6.67	6.62	4.92	3.31	3.13	2.49	3.66	3.39	3.39	2.81	2.93	3.87	3.64	1.64
1987	6.78	6.71	5.13	3.24	3.44	2.80	3.71	3.45	3.45	2.86	2.98	3.93	3.70	1.69
1988	6.88	6.79	5.34	3.17	3.75	3.11	3.77	3.51	3.51	2.91	3.03	3.99	3.76	1.73
1989	6.99	6.87	5.55	3.10	4.06	3.42	3.83	3.56	3.56	2.97	3.08	4.05	3.81	1.78
1990	7.09	6.95	5.76	3.03	4.37	3.73	3.88	3.62	3.62	3.02	3.13	4.10	3.87	1.83
1991	7.09	6.95	5.76	3.03	4.37	3.73	3.88	3.62	3.62	3.02	3.13	4.10	3.87	1.83

[42 FR 33166, June 24, 1977. Redesignated and amended at 44 FR 37938, June 29, 1979]

APPENDIX B TO PART 450—DISCOUNT FACTORS

[Discounting rate of 10 percent]

Year since implementation	Discount factors [1]
1	0.909091
2	0.826446
3	0.751315
4	0.683013
5	0.620921
6	0.564474
7	0.513158
8	0.466507
9	0.424098
10	0.385543
11	0.350494
12	0.318631
13	0.289664
14	0.263331
15	0.239392
16	0.217629
17	0.197845
18	0.179859
20	0.148644
21	0.135131
22	0.122846
23	0.111678
24	0.101526
25	0.092296

[1] The discount factors presented in the table above assume end-of-year lump-sum costs and returns. When costs and returns occur in a steady stream, applying mid-year discount factors may be appropriate. Present value cost and benefit computed from this table can be converted to a mid-year discounting basis by multiplying them by the factor 1.048809. (For example, if the present value cost of a series of annual expenditures computed from the above table is $1,200.00, the present value cost on a mid-year discounting basis is $1,200.00 × 1.048809 or $1,258.57.)

[42 FR 33187, June 19, 1977. Redesignated and amended at 44 FR 37939, June 29, 1979]

APPENDIX C TO PART 450—FACTORS TO ADJUST FUTURE PRINCIPAL AND INTEREST PAYMENTS TO BASE YEAR EQUIVALENT VALUES

Year since base year	Adjustment factor
1	0.9524
2	0.9070
3	0.8638
4	0.8227
5	0.7835
6	0.7462
7	0.7107
8	0.6768
9	0.6446
10	0.6139
11	0.5847
12	0.5568
13	0.5303
14	0.5051
15	0.4810
16	0.4581
17	0.4363
18	0.4155
19	0.3957
20	0.3769
21	0.3589
22	0.3418
23	0.3256
24	0.3101
25	0.2953

[42 FR 33188, June 29, 1977. Redesignated and amended at 44 FR 37939, June 29, 1979]

PART 455—GRANT PROGRAMS FOR SCHOOLS AND HOSPITALS AND BUILDINGS OWNED BY UNITS OF LOCAL GOVERNMENT AND PUBLIC CARE INSTITUTIONS

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AUTHORITY: Title III of the National Energy Conservation Policy Act, Pub. L. 95-619, 92 Stat. 3238 (42 U.S.C. 6371 *et seq.*); and Department of Energy Organization Act, Pub. L. 95-91, 91 Stat. 565 (42 U.S.C. 7101 *et seq.*)

SOURCE: 50 FR 18353, Apr. 30, 1985, unless otherwise noted.

Subpart A—General Provisions

§ 455.1 Purpose and scope.

(a) This part establishes programs of financial assistance pursuant to Parts 1 and 2 of Title III of the National Energy Conservation Policy Act, Pub. L. 95-619, 92 Stat. 3238 (42 U.S.C. 6371 *et seq.*) which add Parts G and H, respectively, to Title III of the Energy Policy and Conservation Act, Pub. L. 94-163, 89 Stat. 901 (42 U.S.C. 6291).

(b) This subpart authorizes grants to States or to public or nonprofit schools and hospitals to assist them in conducting preliminary energy audits and energy audits, in identifying and implementing energy conservation maintenance and operating procedures, and in evaluating, acquiring and installing energy conservation measures, including renewable resource measures, to reduce the energy use and anticipated energy costs of buildings owned by schools and hospitals.

(c) This subpart also authorizes grants to States or units of local government and public care institutions to assist them in conducting preliminary energy audits and energy audits, in identifying and implementing energy conservation maintenance and operating procedures, and evaluating energy conservation measures, including renewable resource measures, to reduce the energy use and anticipated energy costs of buildings owned by units of local government and public care institutions.

§ 455.2 Definitions.

Act, as used in this part, means the Energy Policy and Conservation Act, Pub. L. 94-163, 89 Stat. 871 (42 U.S.C. 6201 *et seq.*), *as amended* by Title III of the National Energy Conservation Policy Act, Pub. L. 95-619, 92 Stat. 3238 (42 U.S.C. 6371).

Assistant Secretary means the Assistant Secretary for Conservation and Renewable Energy or official to whom the Assistant Secretary's functions may be redelegated by the Secretary.

Auditor means any person who is qualified in accordance with 10 CFR 450.44 to conduct an energy audit.

Building means any structure, the construction of which was completed on or before April 20, 1977, which includes a heating or cooling system, or both.

Civil rights requirements means civil rights responsibilities of applicants and grantees pursuant to the Nondiscrimination in Federally Assisted Programs regulation of the Department of Energy (10 CFR Part 1040).

Complex means a closely situated group of buildings on a contiguous site, or a closely situated group of buildings served by a central utility plant, such as a college campus or a multi-building hospital.

Construction completion means the date of issuance of an occupancy permit for a building or the date the building is ready for occupancy as determined by DOE.

Cooling degree days means the annual sum of the number of Fahrenheit degrees of each day's mean temperature above 65° for a given locality.

Coordinating agency means any public or nonprofit organization legally constituted within a State for either administrative control or services for a group of institutions within a State and which acts, and is authorized by eligible institutions to so act, as the agent for such institutions with respect to their participation in the program.

Deputy Assistant Secretary means the Deputy Assistant Secretary for Technical and Financial Assistant or any official to whom the Deputy Assistant Secretary's functions may be redelegated by the Assistant Secretary.

DOE means the Department of Energy.

Energy audit means any survey of a building or complex conducted in accordance with the requirements of § 455.19.

Energy conservation maintenance and operating procedures means modifications in the maintenance and operations of a building, and any installation therein, which are designed to reduce the energy use in such building and which require no significant expenditure of funds.

Energy conservation measure means an installation or modification of an installation in a building which is primarily intended to reduce energy consumption or allow the use of an alternative energy source and which may contain integral control and measurement devices, but which is not an installation of leased equipment, including, but not limited to—

(a) Insulation of the building structure and systems within the building;

(b) Storm windows and doors, multiglazed windows and doors, heat absorbing or heat reflective glazed and coated windows and door systems, additional glazing, reductions in glass area, and other window and door systems modifications;

(c) Automatic energy control systems which would reduce energy consumption;

(d) Equipment required to operate variable steam, hydraulic, and ventilating systems adjusted by automatic energy control systems;

(e) Active or passive solar space heating or cooling systems, solar electric generating systems, or any combination thereof;

(f) Active or passive solar water heating systems;

(g) Furnace or utility plant and distribution system modifications including—

(1) Replacement burners, furnaces, boilers, or any combination thereof, which substantially increase the energy efficiency of the heating system;

(2) Devices for modifying flue openings which will increase the energy efficiency of the heating system;

(3) Electrical or mechanical furnace ignition systems which replace standing gas pilot lights; and

(4) Utility plant system conversion measures including conversion of existing oil and gas-fired boiler installations to alternative energy sources, including coal;

(h) Addition of caulking and weatherstripping;

(i) Replacement or modification of lighting fixtures to increase the energy efficiency of the lighting system without increasing the overall illumination of a facility, unless such increase in illumination is necessary to conform to any applicable State or local building code or, if no such code applies, the increase is considered appropriate by the Secretary;

(j) Energy recovery systems;

(k) Cogeneration systems which produce steam or forms of energy such as heat, as well as electricity for use primarily within a building or a complex of buildings owned by an eligible institution and which meet such fuel efficiency requirements as the Secretary may by rule prescribe;

(l) Such other measures as the Secretary identifies by rule for purposes of this part, as set forth in Subpart D of 10 CFR Part 450; and

(m) Such other measures as a grant application shows will save a substantial amount of energy and are identified in an energy audit in accordance with § 455.19, its equivalent, an energy use evaluation, or a technical assistance report.

Energy use evaluation means an evaluation of the energy use characteristics of a building, which may be used in place of an energy audit when a State has made provision for such use in its State plan and must contain the information set forth in § 455.20.

Fuel means any commercial source of energy used within the building or complex being surveyed such as natural gas, fuel oil, electricity, or coal.

Governor means the chief executive officer of a State, including the Mayor of the District of Columbia, or a person duly designated in writing by the Governor to act on her or his behalf.

Grantee means the entity or organization named in the Notice of Financial Assistance Award as the recipient of the grant.

Grant program cycle means the period of time specified by DOE which relates to the fiscal year or years for which monies are appropriated for grants under this part, during which one complete cycle of DOE grant activity occurs, including fund allocations to the States; applications receipt, review, approval or disapproval; and award of grants by DOE, but which does not include the grantee's performance period.

Gross square feet means the sum of all heated or cooled floor areas enclosed in a building, calculated from the outside dimensions, or from the centerline of common walls.

Heating or cooling system means any mechanical system for heating, cooling or ventilating areas of a building, including a system of through-the-wall air conditioning units.

Heating degree days means the annual sum of the number of Fahrenheit degrees for each day's mean temperature below 65° for a given locality.

Hospital means a public or nonprofit institution which is a general hospital, tuberculosis hospital, or any other type of hospital, other than a hospital furnishing primarily domiciliary care; and which is duly authorized to provide hospital services under the laws of the State in which it is situated.

Hospital facilities means buildings housing a hospital and related facilities, including laboratories, laundries, outpatient departments, nurses' home and training facilities and central service facilities operated in connection with a hospital, and also includes buildings housing education or training facilities for health professions personnel operated as a integral part of a hospital.

Indian tribe means any tribe, band, nation, or other organized group or community of Indians, including any Alaska native village, or regional or village corporation, as defined in or established pursuant to the Alaska Native Claims Settlement Act, Pub. L. 92-203; 85 Stat. 688, which (a) is recognized as eligible for the special programs and services provided by the United States to Indians because of their status as Indians; or (b) is located on, or in proximity to, a Federal or State reservation or rancheria.

Local educational agency means a public board of education or other public authority or a nonprofit institution legally constituted within, or otherwise recognized by, a State for either administrative control or direction of, or to perform administrative services for, a group of schools within a State.

Maintenance means activities undertaken in a building to assure that equipment and energy-using systems operate effectively and efficiently.

Native American means a person who is a member of an Indian tribe.

Operating means the operation of equipment and energy-using systems in a building to achieve or maintain specified levels of environmental conditions of service.

Operations Office Manager means the manager of a DOE Operations Office or the manager's designee, or any official to whom the manager's functions may be redelegated by the Secretary.

Owned or *Owns* means property interest, including without limitation a leasehold interest, which is, or shall become, a fee simple title in a building or complex.

Preliminary energy audit means any survey of a building or complex conducted in accordance with the requirements of § 455.18.

Primarily occupied means that in excess of 50 percent of a building's square footage or time of occupancy is occupied by a public care institution or an office or agency of a unit of local government.

Public care institution means a public or nonprofit institution which owns—

(a) A facility for long-term care, rehabilitation facility, or public health center, as described in section 1633 of the Public Health Service Act (42 U.S.C. 300s-3; 88 Stat. 2270); or

(b) A residential child care center, which is an institution, other than a foster home, operated by a public or nonprofit institution and is primarily intended to provide full-time residential care with an average length of stay of at least 30 days for at least 10 minor persons who are in the care of such institution as a result of a finding of abandonment or neglect or of being persons in need of treatment or supervision.

Public or nonprofit institution means an institution owned and operated by—

(a) A State, a political subdivision of a State or an agency or instrumentality of either; or

(b) A school or hospital which is, or would be in the case of such entities situated in American Samoa, Guam, Puerto Rico, the Commonwealth of the Northern Mariana Islands, and the Virgin Islands, exempt from income tax under section 501(c)(3) of the Internal Revenue Code of 1954; or

(c) A unit of local government or public care institution which is, or would be in the case of such entities situated in American Samoa, Guam, Puerto Rico, the Commonwealth of the Northern Mariana Islands, and the Virgin Islands, exempt from income tax under section 510(c)(3) or 501(c)(4) of the Internal Revenue Code of 1954.

School means a public or nonprofit institution which—

(a) Provides, and is legally authorized to provide, elementary education or secondary education, or both, on a day or residential basis;

(b) (1) Provides, and is legally authorized to provide, a program of education beyond secondary education, on a day or residential basis;

(2) Admits as students only persons having a certificate of graduation from a school providing secondary education, or the recognized equivalent of such certificate;

(3) Is accredited by a nationally recognized accrediting agency or association; and

(4) Provides an educational program for which it awards a bachelor's degree or higher degree or provides not less than a two-year program which is acceptable for full credit toward such a degree at any institution which meets the preceding requirements and which provides such a program;

(c) Provides not less than a one-year program of training to prepare students for gainful employment in a recognized occupation and which meets the provisions cited in paragraphs (b) (1), (2) and (3) of this definition; or

(d) Is a local educational agency.

School facilities means buildings housing classrooms, laboratories, dormitories, athletic facilities, or related facilities operated in connection with a school.

Secretary means the Secretary of the Department of Energy, or his/her designee.

State means, in addition to the several States of the Union, the District of Columbia, Puerto Rico, Guam, American Samoa, the Commonwealth of the Northern Mariana Islands and the Virgin Islands.

State energy agency means the State agency responsible for developing State energy conservation plans pursuant to section 362 of the Energy Policy and Conservation Act (42 U.S.C. 6322), or, if no such agency exists, a State agency designated by the Governor of such State to prepare and submit the State Plan required under section 394 of the Energy Policy and Conservation Act.

State hospital facilities agency means an existing agency which is broadly representative of the public hospitals and the nonprofit hospitals, or, if no such agency exists, an agency designated by the Governor of such State which conforms to the requirements of this definition.

State school facilities agency means an existing agency which is broadly representative of public institutions of higher education, nonprofit institutions of higher education, public elementary and secondary schools, nonprofit elementary and secondary schools, public vocational education institutions, nonprofit vocational education institutions, and the interests of handicapped persons in a State or, if no such agency exists, an agency which is designated by the Governor of such state which conforms to the requirements of this definition.

Technical assistance means a program or activity for (1) the conduct of specialized studies to identify and specify energy savings and related cost savings that are likely to be realized as a result of modifying maintenance and operating procedures in a building, acquiring and installing one or more specified energy conservation measures in a building, or both; and (2) the planning or administration of such specialized studies. For schools and hospitals which are eligible to receive grants to carry out energy conservation measures, the term also means the planning or administration of specific remodeling, renovation, repair, replacement, or insulation projects related to the installation of energy conservation, or renewable resource measures in a building.

Unit of local government means the government of a county, municipality, parish, borough, or township, which is a unit of general purpose government below the State (determined on the basis of the same principles as are used by the Bureau of the Census for general statistical purposes) and the District of Columbia. Such term also means the recognized governing body of an Indian tribe which governing body performs substantial governmental functions and includes libraries which serve all residents of a political subdivision below the State level (such as a community, district or region) free of charge and which derive at least 40 percent of their operating funds from tax revenues of a taxing authority below the State level.

[50 FR 18353, Apr. 30, 1985, as amended at 55 FR 41326, Oct. 10, 1990]

§ 455.3 Administration of grants.

Grants provided under this part shall comply with applicable law, regulation or procedure including, without limitation, the requirements of:

(a) The DOE Financial Assistance Rules (10 CFR Part 600 as amended), except as otherwise provided in this rule;

(b) Executive Order 12372 entitled "Intergovernmental Review of Federal Programs," (48 FR 3130, January 24, 1983), and the DOE regulation implementing this Executive Order entitled "Intergovernmental Review of Department of Energy Programs and Activities" (10 CFR Part 1005);

(c) Office of Management and Budget Circular A-97, entitled "Rules and Regulations Permitting Federal Agencies to Provide Specified or Technical Services to State and Local Units of Government under Title III of the Inter-Governmental Coordination Act of 1968";

(d) DOE regulation entitled "Nondiscrimination in Federally Assisted Programs" (10 CFR part 1040) which implements the following public laws: Title VI of the Civil Rights Act of 1964; section 16 of the Federal Energy Administration Act of 1974; section 401 of the Energy Reorganization Act of 1974; Title IX of the Education Amendments of 1972; The Age Discrimination Act of 1975; and section 504 of the Rehabilitation Act of 1973; and

(e) Such other procedures applicable to this part as DOE may from time to time prescribe for the administration of financial assistance.

§ 455.4 Recordkeeping.

Each State or other entity within a State receiving financial assistance under this part shall make and retain records required and specified by the DOE Financial Assistance Rules, 10 CFR Part 600.

§ 455.5 Suspension and termination of grants.

Suspension and termination procedures shall be as set forth in the DOE Financial Assistance Rules, 10 CFR Part 600.

Subpart B—Preliminary Energy Audit and Energy Audit Grant Procedures

§ 455.10 Purpose and scope.

(a) This subpart contains the regulations whereby the Federal Government shall provide financial assistance for preliminary energy audits and energy audits.

(b) Preliminary energy audits are to be performed by States for the purpose of—

(1) Determining the energy use characteristics of eligible school and hospital facilities, and buildings owned by units of local government and public care institutions, including the size, type, rate of energy use and major energy using systems of such buildings within the State;

(2) Establishing a data base from which reasonably accurate estimates can be made of the number of eligible institutions, the number of qualifying buildings, and patterns of energy conservation needs including an indication of the opportunities for use of renewable energy sources; and

(3) Assisting States in development of a sound and complete State Plan which is a prerequisite to receipt of financial assistance for technical assistance or energy conservation measures, including renewable resource measures.

(c) Energy audits are to be performed by States or eligible schools, hospitals, units of local government and public care institutions for the purpose of—

(1) Determining the energy use characteristics of eligible school and hospital facilities, and buildings owned by units of local government and public care institutions, including the size, type, rate of energy use and major energy using systems of such buildings within the State;

(2) Identifying and encouraging adoption of energy conservation maintenance and operating procedures;

(3) Indicating potential, if any, for acquiring and installing energy conservation measures, including possible use of renewable resources; and

(4) Providing, to the greatest extent practicable, consistent information necessary to identify those buildings to receive priority for additional financial assistance.

§ 455.11 Financial assistance.

(a) DOE shall provide financial assistance from sums appropriated only upon application in accordance with the provisions of this subpart.

(b) The Secretary may make grants for purposes of conducting preliminary energy audits and energy audits of school facilities and hospital facilities.

(c) The Secretary may make grants for purposes of conducting preliminary energy audits and energy audits of buildings owned by units of local government and public care institutions.

§ 455.12 Cost sharing.

(a) Amounts made available under this subpart, together with any other amounts made available from other Federal sources, may not be used to pay more than 50 percent of the costs of a preliminary energy audit or an energy audit, except as provided in paragraph (b) of this section.

(b) The Governor of a State may request a grant of up to 100 percent of the costs of any preliminary energy audit or energy audit for schools or hospitals. When financial assistance in excess of the 50 percent cost share limitation is provided to a State, the sum allocated to that State for technical assistance and energy conservation measures, including renewable resource measures shall be reduced by an equal amount. Such funds shall be reallocated among all other States on the same basis as the initial allocation. The Secretary may make such a grant if the State has demonstrated that—

(1) The State would otherwise be unable to participate in the program; and

(2) The amount of the additional financial assistance requested is the minimum necessary to allow the State to participate.

(c) Where a State has expended funds without financial assistance under this subpart for the conduct of preliminary energy audits or energy audits commenced on or after November 9, 1978, the Secretary may, upon application and approval under this subpart, accept all or any portion of such expenditures as constituting State matching funds.

(d) To the extent that funds allocated to a State for preliminary energy audits and energy audits are not needed because all potentially eligible buildings have had or will have an energy audit or its equivalent conducted, such funds may be made available for technical assistance or energy conservation measures. DOE shall, upon request by the State, redistribute funds not needed for preliminary energy audits and energy audits to the State allocation for technical assistance or energy conservation measures, as appropriate, and such funds shall be in addition to those which would otherwise be available for such purposes.

(e) Amounts to be used to meet the cost-sharing requirements described in Subpart G of this part must meet the requirements for cost-sharing set forth in the DOE Financial Assistance Rules, 10 CFR 600.107.

§ 455.13 Allocation of funds.

(a) Financial assistance for conducting preliminary energy audits and energy audits of school facilities and hospital facilities shall be allocated among the States by multiplying the sum available by the allocation factor (F).

(b) Financial assistance for conducting preliminary energy audits and energy audits of buildings owned by units of local government and public care institutions shall be allocated among the States by multiplying the sum available by the allocation factor (F).

(c) The allocation factor (F) shall be determined by the formula—

$$F = \frac{(.1)}{(n)} + \frac{(.7SP)}{(NP)} + \frac{(.2SC)}{(NC)}$$

where, as determined by DOE—

(1) n is the total number of States;

(2) SP is the population of the State, as determined from 1976 census estimates, "Current Population Reports" Series p-25, number 642, or territory as determined from 1973 census estimates, "Current Population Reports", Series p-25, number 603;

(3) NP is 217,820,000, the total population of all States;

(4) SC is the sum of the State's heating and cooling degree days, as determined from National Oceanic and Atmospheric Administration data for the thirty year period, 1941 through 1970; and

(5) NC is 347,729, the sum of all States' heating and cooling degree days.

(d) Financial assistance allocated to a State pursuant to this subpart for a grant program cycle which remains unobligated at the end of the grant program cycle shall, if available, be reallocated under paragraph (a) or (b) of this section, as appropriate, in the subsequent grant program cycle.

§ 455.14 Submission and review of applications.

(a) To be eligible to receive financial assistance, a State shall complete and submit an original copy of the application to the Secretary. Such application shall be signed by the Governor or his designee.

(b) The first State application shall be submitted not later than 30 days after the effective date of this subpart. Subsequent State applications shall be submitted for each grant program cycle on or before the date established by the Secretary for—

(1) Schools and hospitals;

(2) Buildings owned by units of local government and public care institutions; or

(3) Both.

(c) The State shall consult with representatives of schools, hospitals, units of local government and public care institutions during the preparation of applications for financial assistance for preliminary energy audits and energy audits.

(d) The Governor may request an extension of the submission date for a State's application by sending a written request to the Secretary prior to the date upon which it is due. An extension will only be provided for good cause shown. Such a request shall include a brief discussion of work remaining to be done on the application and time required for its completion. An extension shall not exceed 60 days except where additional time may be required by a State to enact enabling legislation, or where the Secretary finds an additional extension to be consistent with the overall objectives of the Act and the requirements of this subpart.

(e) The Secretary shall review each timely State application and provide financial assistance if the Secretary determines that the application meets the objectives of the Act and the requirements of this part.

(f) All or any portion of an application under this section may be disapproved to the extent that funds are not available under this subpart to carry out such application or portion thereof.

(g) The Secretary shall state in writing the reasons any application is disapproved. Applications not approved by the Secretary may be resubmitted by the applicant at any time within the grant program cycle in the same manner as the original application, and the Secretary shall approve such resubmitted application if it is found to be in compliance with the requirements of this subpart. Amendments of an application shall, except as the Secretary may otherwise provide, be subject to approval in the same manner as the original application.

§ 455.15 Content of applications.

(a) An application shall contain—

(1) The name and mailing address of the proposed State grantee;

(2) A budget which shall include identification of the sources, amounts, and intended use of non-Federal funds required to meet the cost-sharing provisions of § 455.12; and

(3) Assurance that preliminary energy audit and energy audit procedures to be employed will meet the requirements of §§ 455.18 and 455.19.

(b) For each program for which financial assistance is sought, a State application shall also contain—

(1) A timetable, including a listing of milestones for the activities to be carried out by calendar quarters for each program for which financial assistance will be provided;

(2) A description of materials to be developed and adopted, or an identification of existing materials to be used, to meet the requirements for conducting preliminary energy audits and energy audits set forth in §§ 455.18 and 455.19, including provision of data concerning heating degree days, cooling degree days, insolation, and wind speed for regions within the State;

(3) A description of the training to be provided to those persons who will conduct energy audits. Such training shall, at a minimum, use as instructors, architects or engineers who have had practical experience in performing energy audits. The minimum qualifications of those attending the training course, and the minimum qualifications of those who will be permitted to perform energy audits without having attended the training course, shall also be described.

(4) An explanation of how the size of the sample and the selection of sample buildings will be determined in those instances where a sampling methodology is used in the conduct of preliminary energy audits.

(5) A description of the methods which will be used to advise eligible institutions of the availability of assistance under this subpart, and the amounts available by categories of institutions as determined under paragraphs (c)(3) and (d)(2) of this section.

(c) A State application for financial assistance to conduct preliminary energy audits and energy audits of school and hospital facilities shall contain—

(1) A description of the procedures the State will use to provide funding or services to those schools and hospi-

als which are willing and able to conduct their own energy audits;

(2) A justification for any funding applied for in excess of the 50 percent limit provided in paragraph (a) of § 455.12;

(3) A description of the method by which funds will be apportioned between school facilities and hospital facilities, including a justification for the apportionment if fewer than all such facilities will be audited;

(4) An explanation of the manner in which activities to be conducted shall be consistent with—

(i) Related State programs for educational facilities in such State; and

(ii) State health plans under sections 1524(c)(2) (42 U.S.C. 300m-3; 88 Stat. 2247) and 1603 (42 U.S.C. 300o-2; 88 Stat. 2259) of the Public Health Service Act; and

(5) A description of the actions taken by the State to solicit and consider the views of representatives of schools and hospitals during the preparation of the State's application.

(d) A State application for financial assistance to conduct preliminary energy audits and energy audits of buildings owned by the units of local government and public care institutions shall contain a description of—

(1) The procedures the State will use to provide funding or services to those units of local government and public care institutions which are willing and able to conduct their own energy audits.

(2) The method by which funds will be apportioned between buildings owned by units of local government and public care institutions including a justification for the apportionment if fewer than all these buildings will be audited; and

(3) The action taken by the State to solicit and consider the views of representatives of units of local government and public care institutions during the preparation of the State's application.

(e) A State application shall set forth procedures—

(1) By which buildings or complexes eligible for preliminary energy audits and energy audits will be identified, and a listing thereof prepared and maintained;

(2) For the State to participate, on a selective sampling basis, in the performance of on-site energy audits to assure that the findings present a reasonably thorough and accurate assessment of the buildings surveyed; and

(3) For the State to conduct follow-up visits, on a selective sampling basis, to ascertain the degree of implementation of energy audit results.

§ 455.16 Use of funds.

(a) A State shall either carry out preliminary energy audits and energy audits of schools and hospitals, or provide for the conduct of such audits by schools and hospitals, through use of funds which the State has received pursuant to paragraph (b) of § 455.11.

(b) A State shall either carry out preliminary energy audits and energy audits of buildings owned by units of local government and public care institutions, or provide for the conduct of such audits by units of local goverment and public care institutions, through the use of funds which the State has received pursuant to paragraph (c) of § 455.11.

(c) No financial assistance provided under this subpart shall be expended for—

(1) The audit of—

(i) A vacant, unused or condemned building;

(ii) A stadium which is part of a school facility used primarily for exhibitions for which admission is charged and which is not also generally used for intramural sports and physical fitness programs generally available to all students; or

(iii) A building or complex owned by a unit of local government or a public care institution—

(A) Not primarily occupied by such institution; or

(B) Which is intended for seasonal use; and

(2) The purchase or acquisition of any single piece of equipment or tangible personal property costing more than $500 to be used in conducting preliminary energy audits or energy audits, unless prior written approval has been obtained from DOE.

(d) Of the financial assistance provided to a State under this subpart, not more than 25 percent shall be expended for—

(1) Administrative expenses;

(2) Development of materials for the conduct of preliminary energy audits and energy audits;

(3) Training of personnel to conduct energy audits;

(4) For conducting preliminary energy audits and sample energy audits; and

(5) For monitoring and evaluation.

(e) At least 75 percent of the financial assistance provided under this subpart shall be used in conducting energy audits of buildings, including costs of personnel attending training sessions conducted by the State preparatory to performing energy audits.

(f) A State may request, and the Secretary may approve, a waiver of the limitations required under paragraph (d) and (e) of this section, provided the State demonstrates that such a waiver would permit the conduct of more energy audits than would otherwise be conducted under the provisions of this section.

§ 455.17 Reporting requirements.

(a) Each State receiving financial assistance under this part shall submit to DOE a quarterly program performance report and a quarterly financial status report. The reports shall be submitted to DOE within 30 days following the end of each calendar quarter.

(b) The quarterly program performance report shall include—

(1) For those building which have received a preliminary energy audit or an energy audit, a summary of the categories, types of ownership, functional uses, gross square feet and energy use levels; and

(2) For those buildings which have received an energy audit—

(i) An estimate of the savings anticipated from energy conservation operation and maintenance procedure changes identified; and

(ii) An approximation of the energy savings indicated from applicable energy conservation measures if the procedure used by the State results in such information or a summary of the number of buildings for which the energy audit indicates potential for energy conservation measures, including renewable resource measures.

(c) The second quarterly report shall also include—

(1) The total sum required for energy audits of buildings whose owners have been advised of selection to receive an energy audit;

(2) A copy of the materials adopted by the State for conducting energy audits;

(3) The apportionment of funds pursuant to paragraphs (c)(3) and (d)(2) of § 455.15 and the data on which such apportionment was based;

(4) The listing of institutions and their buildings compiled pursuant to the provisions of paragraph (e)(1) of § 455.15, summarized by category, types of ownership, and functional use;

(5) Any necessary revisions to the estimate of the characteristics and energy conservation potential of buildings owned by eligible institutions resulting from the sample preliminary energy audits, if a sampling approach was used.

(d) Copies of preliminary energy audit and energy audit reports made by or furnished to the State under § 450.45 of this chapter shall be submitted to DOE together with the quarterly report.

(e) Reports shall contain such other information as may be required by DOE.

§ 455.18 Contents of a preliminary energy audit.

(a) A preliminary energy audit shall provide a description of the building or complex audited and determine its energy-using characteristics, including—

(1) The name or other identification and address of the building;

(2) A statement that the building meets the requirements of one of the following categories—

(i) A school facility;

(ii) A hospital facility; or

(iii) A building owned and primarily occupied either by offices or agencies of a unit of local government or by a public care institution, neither of which shall include any building intended for seasonal use or any building used primarily by a school or hospital;

(3) A description of the functional use made of the building identifying whether it is a—

(i) School—

(A) Elementary;

(B) Secondary;

(C) College or university;

(D) Vocational;

(E) Other;

(ii) Hospital—

(A) General;

(B) Tuberculosis; or

(C) Other;

(iii) Local government building—

(A) Office;

(B) Storage;

(C) Service;

(D) Library;

(E) Police station;

(F) Fire station; or

(G) Other; or

(iv) Public care building—

(A) Nursing home;

(B) Long term care other than a nursing home;

(C) Rehabilitation facility;

(D) Public health center; or

(E) Residential child care center;

(4) The name and address of the owner of record, indicating whether owned by a public institution, private nonprofit institution or an Indian tribe;

(5) The size of the building, expressed in gross square feet;

(6) The age of the building;

(7) Approximate daily hours of operation, including periods of partial use if applicable;

(8) An indication of whether the building is partially used during vacation periods or other times when the building is not fully utilized, for periods of a week or more, by quarter;

(9) An identification of major energy-using systems, including—

(i) Type of heating system or cooling system or both;

(ii) Fuel used for heating system, cooling system;

(iii) Fuel used for domestic hot water, such as electric or natural gas;

(iv) Special energy using systems, such as food service or laundry; and

(v) Lighting, such as incandescent or fluorescent;

(10) Fuel use in physical units and cost data by type for a preceding 12 month period, by month if practicable, using actual data or an estimate if actual figures are unavailable; and

(11) Total annual energy use expressed in Btu's per gross square foot and energy cost per gross square foot.

(b) A preliminary energy audit shall provide a brief description of activities which have been undertaken to conserve energy in the building or complex being audited, including whether—

(1) A person has been designated to monitor and evaluate energy use;

(2) Work partially or fully satisfying the requirements of an energy audit has been performed;

(3) Detailed studies have been conducted by architects, engineers or architect-engineer teams of energy use and energy conservation; and

(4) Any major energy conservation measures have been implemented, together with a listing of such measures, and estimates of their costs and energy savings if available.

(c) A preliminary energy audit shall provide information regarding site, building, and heating and hot water systems related to renewable resource potential, including—

(1) An indication of whether open land, such as fields, yards and parking areas, is available within the immediate vicinity of the building which is not heavily shaded by tall buildings, trees or other obstructions;

(2) A statement of whether the building is located generally within an urban, suburban or rural area;

(3) An approximation of whether more than half the building's roof area or southern oriented wall surface is heavily shaded by shrubs, trees, buildings or other obstructions for more than about four hours per day;

(4) The number of stories;

(5) A general description of the building's shape, such as square, rectangular, E-shaped, H-shaped or L-shaped;

(6) An indication of whether the roof is flat or pitched, and if pitched whether is has a southern orientation;

(7) Whether there are existing rooftop obstructions, such as chimneys, space conditioning equipment, water towers, mechanical rooms, stairwells or other permanent structures;

(8) An indication of the exterior material of the southern facing wall, such as masonry, wood, aluminum;

(9) An approximation of the proportion of glass area of the southern facing wall, such as less than 25 percent, 25-75 percent, more than 75 percent; and

(10) Location of primary space heating and water heating systems—

(i) Whether outside of or within the building;

(ii) If within the building, whether on the ground floor, in the basement, or on the roof; and

(iii) If within the building, whether centrally located, in multiple units, or a combination thereof.

§ 455.19 Contents of an energy audit.

(a) An energy audit shall contain the information required for a preliminary energy audit, in accordance with § 455.18, and shall also include a description of—

(1) Major changes in functional use or mode of operation planned in the next fifteen years, such as demolition, disposal, rehabilitation, or conversion from office to warehouse;

(2) For a building in excess of 200,000 gross square feet, if available—

(i) Peak electric demand for both daily and annual cycle; and

(ii) Annual energy use by fuel type of the major mechanical or electrical systems if the information is available or can be reasonably estimated;

(3) Terminal heating or cooling, or both, such as radiators, unit ventilators, fancoil units, or double-duct reheat systems;

(4) Building site and structural characteristics related to renewable resource potential, including but not limited to—

(i) Climatic factors, specifically—

(A) Average annual heating degree days and cooling degree days;

(B) Average solar insolation by month;

(C) Average monthly wind speed; and

(ii) Roof characteristics, including—

(A) An identification of primary structural component such as steel, wood, concrete; and

(B) Type of roofing material such as shingles, slate or built-up material; and

(5) A description of general building conditions.

(b) An energy audit shall—

(1) Indicate that appropriate energy conservation maintenance and operating procedures have been implemented for the building, supported by a demonstration based on actual records, that energy use has been reduced in a given year through changes in maintenance and operating procedures, by not less than 20 percent from a corresponding based period having a degree day variance of less than 10 percent; or

(2) Recommended appropriate energy conservation maintenance and operating procedures, on the basis of an on-site inspection and review of any scheduled preventive maintenance plan, together with a general estimate or range of energy and cost savings if practical, which may result from—

(i) Effective operation of ventilation systems and control of infiltration conditions, including—

(A) Repair of caulking or weatherstripping around windows and doors;

(B) Reduction of outside air intake, shutting down ventilation systems in unoccupied areas, and shutting down ventilation systems when the building is not occupied; and

(C) Assuring central or unitary ventilation controls, or both, are operating properly;

(ii) Changes in the operation of heating or cooling systems through—

(A) Lowering or raising indoor temperatures;

(B) Locking thermostats;

(C) Adjusting supply or heat transfer medium temperatures; and

(D) Reducing or eliminating heating or cooling at night or at times when a building or complex is unoccupied;

(iii) Changes in the operation of lighting systems through—

(A) Reducing illumination levels;

(B) Maximizing use of daylight;

(C) Using higher efficiency lamps; and

(D) Reducing or eliminating evening cleaning of buildings;

(iv) Changes in the operation of water systems through—

(A) Repairing leaks;

(B) Reducing the quantity of water used, e.g., flow restrictors;

(C) Lowering settings for hot water temperatures; and

(D) Raising settings for chilled water temperatures; and

(v) Changes in the maintenance and operating procedures of the utility plant and distribution system through—

(A) Cleaning equipment;

(B) Adjusting air/fuel ratio;

(C) Monitoring combustion;

(D) Adjusting fan, motor, or belt drive systems;

(E) Maintaining steam traps; and

(F) Repairing distribution pipe insulation; and

(vi) Such other actions as the State may determine useful or necessary, consistent with the purposes of the energy audit and acceptable cost constraints of § 450.46.

(c) Based on information gathered under paragraphs (a) and (b) of § 455.18, and paragraphs (a) (1) and (2) of this section, an energy audit shall indicate the need, if any, for the acquisition and installation of energy conservation measures and shall include an evaluation of the need and potential for retrofit based on consideration of one or more of the following—

(1) An energy use index or indices, for example, Btu's per gross square foot per year;

(2) An energy cost index or indices, for example, annual energy costs per gross square foot; or

(3) The physical characteristics of the building envelope and major energy-using systems.

(d) Based on information gathered under paragraph (c) of § 455.18 and paragraph (a)(4) of this section, an energy audit shall include an indication of whether building conditions or characteristics present an opportunity for use of solar heating and cooling systems or solar hot water systems.

(e) An energy audit may include an assessment of the estimated costs and energy and cost savings likely to result from the purchase and installation of one or more energy conservation measures.

§ 455.20 Contents of an energy use evaluation.

(a) An energy use evaluation may be used in lieu of an energy audit in cases where no energy audit has been performed, in accordance with § 455.19, and where the State has made provision for such use in its State plan, in accordance with § 455.90(1).

(b) An energy use evaluation shall contain the information required in § 455.18(a) through 455.18(b)(4), and shall also include a description of—

(1) The building's potential suitability for renewable resource applications;

(2) Major changes in functional use or mode of operation planned in the next fifteen years, such as demolition, disposal, rehabilitation, or conversion from office to warehouse;

(3) Appropriate energy conservation maintenance and operating procedures which have been implemented for the building;

(4) The need, if any, for the acquisition and installation of energy conservation measures, including an assessment of the estimated costs and energy and cost savings likely to result from the purchase and installation of one or more energy conservation measures and an evaluation of the need and potential for retrofit based on consideration of one or more of the following:

(i) An energy use index or indices, for example, Btu's per gross square foot per year;

(ii) An energy cost index or indices, for example, annual energy costs per gross square foot; or

(iii) The physical characteristics of the building envelope and major energy-using systems; and

(5) Such other information as the State has determined useful or necessary, in accordance with § 455.90(1).

Subpart C—Technical Assistance Programs for Schools, Hospitals, Units of Local Government and Public Care Institutions

§ 455.40 Purpose and scope.

This subpart specifies what constitutes a technical assistance program eligible for financial assistance under this part, and sets forth the eligibility criteria for schools, hospitals, units of local government and public care institutions to receive grants for technical assistance to be performed in buildings owned by such institutions.

§ 455.41 Eligibility.

To be eligible to receive financial assistance for a technical assistance program, an applicant must—

(a) Be a school, hospital, unit of local government, public care institution or coordinating agency, all as defined in § 455.2, except that—

(1) Financial assistance for units of local government and public care institutions will be provided only for buildings which are owned and primarily occupied by offices or agencies of a unit of local government or public care institution and which are not intended for seasonal use and not utilized primarily as a school or hospital eligible for assistance under this program; and

(2) Financial assistance provided to a school which is a local education agency as defined in § 455.2 must not be used for a technical assistance program or acquisition or installation of any energy conservation measure in any building of such agency which is used principally for administration.

(b) Be located in a State which has an approved State Plan as described in Subpart H of this part;

(c) Have conducted an energy audit, its equivalent or an energy use evaluation for the building for which financial assistance is to be requested, subsequent to the most recent construction, reconfiguration or utilization change which significantly modified energy use within the building;

(d) Give assurance that it has implemented all energy conservation maintenance and operating procedures identified as a result of the energy audit or its equivalent, identified in the energy use evaluation, or provide a written justification satisfactory to the Secretary, pursuant to § 455.90(j); and

(e) Submit an application in accordance with the provisions of this part and the approved State Plan.

§ 455.42 Contents of program.

(a) The purpose of a technical assistance program is to provide a report which meets the requirements of this section and the State's procedures for implementing this section. A technical assistance program should be designed—

(1) To identify and document energy conservation maintenance and operating procedure changes and energy conservation measures in sufficient detail to support possible application for financial assistance, and to provide reviewers and decisionmakers handling such applications sufficient information upon which to base judgments as to their reasonableness; and

(2) To provide the institution with a description of its current characteristics, procedures, operating and maintenance procedure changes and potential for cost-effective capital improvements such that the report can be used to guide those responsible for the energy and financial management of the institution in implementing energy conservation actions without regard to possible financial assistance under this program.

(b) A technical assistance program shall be conducted by a technical assistance analyst, who has the qualifications established in the State Plan in accordance with § 455.90(p) and who shall consider all feasible energy conservation operating and maintenance procedure changes and energy conservation measures for a building, including renewable resource measures. A technical assistance program shall identify the estimated costs of, and the energy and cost savings likely to be realized from, implementing energy conservation maintenance and operating procedures. A technical assistance program shall also provide a detailed engineering analysis to specify the estimated cost of, and the energy and cost savings likely to be realized from, acquiring and installing each energy conservation measure, including renewable resource measures, that indicate a significant potential for saving energy based upon the technical assistance analyst's initial consideration.

(c) The technical assistance analyst shall use the following factors in calculating costs—

(1) Current prices, including demand charges.

(2) Marginal prices where incremental prices apply.

(d) At the conclusion of a technical assistance program, the technical assistance analyst shall prepare a report which shall include—

(1) A description of building characteristics and energy data including—

(i) The results of the energy audit, its equivalent, or energy use evaluation of the building, together with a statement as to the accuracy of the energy audit data as required in § 455.42(d)(7), and completeness of the energy audit recommendations;

(ii) The operation characteristics of energy using systems; and

(iii) The estimated remaining useful life of the buildings;

(2) An analysis of the estimated energy consumption of the building, by fuel type in total Btu's and Btu/sq. ft./yr. using conversion factors prescribed by the State, at optimum efficiency (assuming implementation of all energy conservation maintenance and operating procedures);

(3) An evaluation of the building's potential for renewable resource conversions; including water heating systems;

(4) A listing of any known local zoning ordinances and building codes which may restrict the installation of solar or renewable resource systems;

(5) A description and analysis of all identified operating and maintenance procedures changes, if any, and energy conservation measures, including renewable resource measures, setting forth—

(i) A description of each operating and maintenance procedure change and an estimate of the costs of adopting such operating and maintenance procedure changes;

(ii) An estimate of the cost of design, acquisition and installation of each energy conservation measure, discussing pertinent assumptions as necessary;

(iii) Estimated useful life of each energy conservation measure;

(iv) An estimate of increases or decreases in maintenance and operating costs that would result from each conservation measure if any;

(v) An estimate of the salvage value or disposal cost of each energy conservation measure at the end of its useful life, if any;

(vi) An estimate supported by all data and assumptions used in arriving at the estimate, of the annual energy and energy cost savings (using current energy prices including demand charges) expected from each operating and maintenance procedure change and the acquisition and installation of each energy conservation measure. In calculating the potential energy cost savings or energy savings of each energy conservation measure, including renewable resource measures, the technical assistance analyst shall—

(A) Assume that all energy savings obtained from energy conservation maintenance and operating procedures have been realized;

(B) Calculate the total energy and energy cost savings, by fuel type, expected to result from the acquisition and installation of all feasible energy conservation measures, taking into account the interaction among the various measures;

(C) Calculate that portion of the total energy and energy costs savings, as determined in paragraph (d)(5)(vi)(B) of this section attributable to each individual energy conservation measure; and

(D) Consider climate and other variables;

(vii) The simple payback period of each energy conservation measure, taking into account the interactions among the various measures. The simple payback period is calculated by dividing the estimated total cost of the measure, as determined pursuant to § 455.42(d)(5)(ii), by the estimated annual cost saving accruing from the measure, as determined pursuant to § 455.42(d)(5)(vi). For the purposes of ranking applications, the simple payback period shall be calculated using the cost savings resulting from energy savings only, determined on the basis of current energy prices except:

(A) For energy conservation measures which result in conversion from oil, natural gas, other petroleum products or electricity to coal, the simple payback period shall be calculated based on the annual cost savings (using current energy prices) associated with the change in fuels; or

(B) For renewable resource energy conservation measures, the simple payback period shall be calculated using the cost of the fuels displaced (using current energy prices) as the annual cost savings; and

(viii) The estimated cost of the measure which shall be the total cost for design and other professional service (excluding cost of a technical assistance program), if any, and acquisition and installation costs. At the request of the applicant, the technical assistance report shall provide a life cycle cost analysis, which considers all costs and cost savings, such as maintenance costs and/or savings, resulting from an energy conservation measure for use by the institution;

(6) Energy use and cost data, actual or estimated, for each fuel type used for the prior 12-month period, by month if possible; and

(7) A signed and dated certification that the technical assistance program has been conducted in accordance with the requirements of this section and that the data presented is accurate to the best of the technical assistance analyst's knowledge.

Subpart D—Energy Conservation Measures for Schools and Hospitals

§ 455.50 Purpose and scope.

This subpart indicates what constitutes an energy conservation measure that may receive financial assistance under this part and sets forth the eligibility criteria for schools and hospitals to receive grants for energy conservation measures, including renewable resource measures.

§ 455.51 Eligibility.

(a) To be eligible to receive financial assistance for an energy conservation measure, including renewable resource measures, an applicant must—

(1) Be a school, hospital or coordinating agency as defined in § 455.2, provided that financial assistance provided to a school which is a local education agency as defined in § 455.2 must not be used for a technical assistance program or acquisition or installation of any energy conservation measure in any building of such agency which is used principally for administration;

(2) Be located in a State which has an approved State Plan as described in Subpart H of this part;

(3) Have completed a technical assistance program or its equivalent, as determined by the State in accordance with the State Plan, for the building for which financial assistance is to be requested, subsequent to the most recent construction, reconfiguration or utilization change to the building which significantly modified energy use within the building;

(4) Have implemented all energy conservation maintenance and operating procedures which are identified as the result of a technical assistance program, or have provided a satisfactory written justification for not implementing any specific maintenance and operating procedures so identified, as described in §455.90(j).

(5) Have no plan or intention at the time of application to close or otherwise dispose of the building for which financial assistance is to be requested within the simple payback period of any energy conservation measure recommended for that building; and

(6) Submit an application in accordance with the provisions of this part and the approved State Plan.

(b) To be eligible for financial assistance, the simple payback period of each energy conservation measure for which financial assistance is requested shall not be less than 2 years nor greater than 10 years, and the estimated useful life of the measure shall be greater than its simple payback period.

§ 455.52 Contents of program.

The programs to be funded under this part will be for the design, acquisition and installation of energy conservation measures to reduce energy consumption or measures to allow the use of solar or other alternative energy resources for schools and hospitals. Such measures include, but are not necessarily limited to those included in the definition of "energy conservation measures" in §455.2.

Subpart E—Applicant Responsibilities

§ 455.60 Grant application submittals.

(a) Each eligible applicant desiring to receive financial assistance shall file an application in accordance with the provisions of this subpart and the approved State Plan of the State in which such building is located. The application, which may be amended in accordance with applicable State procedures at any time prior to the State's final determination thereon, shall be filed with the State energy agency designated in the State Plan.

(b) Applications from schools, hospitals, units of local government, public care institutions and coordinating agencies for financial assistance for technical assistance programs shall include the certifications contained in § 455.61 and—

(1) The applicant's name and mailing address;

(2) The energy audit, its equivalent, or an energy use evaluation (as determined by the State) for each building for which financial assistance is requested;

(3) A project budget, by building, which stipulates the intended use of all Federal and non-Federal funds; including in-kind contributions (valued in accordance with the guidelines in 10 CFR 600.107(e)), to be used to meet the cost-sharing requirements described in Subpart G of this part;

(4) A brief description, by building, of the proposed technical assistance program, including a schedule, with appropriate milestone dates, for completing the technical assistance program; and

(5) Additional information required by the applicable State Plan, and any other information which the applicant desires to have considered, such as information to support an application from a school or hospital for financial assistance in excess of the 50 percent Federal share on the basis of severe hardship or an application which proposes the use of Federal funds, paid under and authorized by another Federal agreement, to meet cost sharing requirements.

(c) Applications from schools and hospitals and coordinating agencies for financial assistance for energy conservation measures, including renewable resource measures, shall include the certifications contained in § 455.61 and—

(1) The applicant's name and mailing address;

(2) Identification of each building pursuant to § 455.18(a) (1) through (5), or an equivalent identification if no preliminary energy audit was performed, for which financial assistance is requested, including—

(i) Name or other identification of each building and its address;

(ii) Building category;

(iii) Description of functional use;

(iv) Ownership; and

(v) Size of building expressed in gross square feet.

(3) A project budget, by measure or by building as provided in the State Plan, which stipulates the intended use of all Federal and non-Federal funds, and identifies the sources and amounts of non-Federal funds, including in-kind contributions (valued in accordance with the guidelines in 10 CFR 600.107(e)) to be used to meet the cost sharing requirements described in Subpart G of this part;

(4) A schedule, including appropriate milestone dates, for the completion of the design, acquisition and installation of the proposed energy conservation measures for each building;

(5) For each energy conservation measure proposed for funding, the projected cost, and the projected simple payback period as contained in § 455.42(d)(5) (vii) and (viii). Applications with more than one energy conservation measure per building shall include projected costs and paybacks for each measure, and the average simple payback period for all measures proposed for the building;

(6) Unless waived by DOE, the report of the technical assistance analyst. This report must have been completed since the most recent construction, reconfiguration or utilization change to the building, which significantly modified energy use, for each building.

(7) If the applicant is aware of any adverse environmental impact which may arise from adoption of any energy conservation measure, and analysis of that impact and the applicant's plan to minimize or avoid such impact; and

(8) Additional information required by the applicable State Plan, and any additional information which the applicant desires to have considered, such as information to support an application for financial assistance in excess of the 50 percent Federal share on the basis of severe hardship, or an application which proposes the use of Federal funds, paid under and authorized by another Federal agreement, to meet cost sharing requirements.

§ 455.61 Applicant certifications.

Applications for financial assistance for technical assistance programs and energy conservation measures, including renewable resource measures, shall include certification that the applicant—

(a) Is eligible under § 455.41 for technical assistance or § 455.51 for energy conservation measures;

(b) Has satisified the requirements set forth in § 455.60;

(c) For applications for technical assistance, has implemented all energy conservation maintenance and operating procedures recommended as a result of the energy audit, its equivalent, or identified in the energy use evaluation, and for applications for energy conservation measures, those recommended in the report obtained under a technical assistance program. If any such procedure has not been implemented, the application shall contain a satisfactory written justification for not implementing that procedure as prescribed pursuant to § 455.90(j);

(d) Will obtain from the technical assistance analyst, before the analyst performs any work in connection with a technical assistance program or energy conservation measure, a signed statement certifying that the technical assistance analyst has no conflicting financial interests and is otherwise qualified to perform the duties of technical assistance analyst in accordance with the standards and criteria established in the approved State Plan;

(e) For a project under this Part having a total estimated cost of more than $5,000, any construction contract or subcontract in excess of $2,000 using any grant funds awarded under this part must include those contract labor standards provisions set forth in 29 CFR 5.5 and a provision for payment of laborers and mechanics at the minimum wage rates determined by the Secretary of Labor in accordance with the Davis-Bacon Act (40 U.S.C. 276a) as set forth in 29 CFR Part 1. For the purpose of this section "project" means an undertaking to acquire and install one or more energy conservation measures in a building which is eligible under this part; and

(f) Will comply with all reporting requirements contained in § 455.63.

§ 455.62 Grant applications for State administrative expenses.

(a) Each State desiring to receive grants to help defray State administrative expenses shall file an application in accordance with the provisions of this section. At any time after notice by DOE of the amounts allocated to each State for a grant program cycle, each State may apply to the Secretary for an amount for administrative expenses not exceeding $30,000 or 2 percent of its total allocation for technical assistance and energy conservation measures, whichever is higher. In addition, each State, after it makes the submittal to DOE required under § 455.72, may apply for a further grant not exceeding 5 percent of the total of all grant awards for technical assistance and energy conservation measures within that State in that grant program cycle, less any amounts previously awarded the State for administrative expenses in the same grant program cycle. In the event that a State cannot or decides not to use the amount available to it for an administrative grant under this section for administrative purposes, these funds may, at the discretion of the State, be used for technical assistance and energy conservation grants to eligible institutions within that State, in accordance with this part.

(b) Applications for financial assistance to defray State administrative expenses shall include—

(1) The name and address of the person designated by the State to be responsible for the State's functions under this part;

(2) An identification of intended use of all Federal and non-Federal funds, for the State administrative expenses listed in § 455.83(c) and a list of the sources and amounts of the required matching non-Federal funds, including in-kind contributions valued in accordance with the guidelines in the DOE Financial Assistance Rules (10 CFR 600.107(e)) to be used to meet the cost-sharing requirements described in Subpart G of this part; and

(3) Any other information required by DOE.

§ 455.63 Grantee records and reports.

(a) Each State, school, hospital, unit of local government, public care institution and coordinating agency which receives a grant for a technical assistance program, energy conservation measure, including renewable resource measures, or State administrative expenses shall keep all the records required by § 455.4 in accordance with DOE Financial Assistance Rules.

(b) Each grantee shall submit reports as follows—

(1) For technical assistance projects, two copies of a final report of the analysis completed on each building for which financial assistance was provided shall be submitted to the State energy agency no later than 90 days following completion of the analysis. These reports shall contain—

(i) The report submitted to the institution by the technical assistance analyst, and

(ii) The institution's plan to implement energy conservation maintenance and operating procedures.

(2) For energy conservation measure projects—

(i) Grantee shall submit semi-annual progress reports. Two copies shall be submitted to the State energy agency no later than the end of July and January and shall detail and discuss milestones accomplished, those not accomplished, status of in-progress activities, and remedial actions if needed to achieve project objectives. A final report may be submitted in lieu of the last semi-annual report if it satisfies the semi-annual progress report and final report designated time frames;

(ii) Grantees shall submit a final report. Two copies shall be submitted to the State within 90 days of the completion of the project and shall list and describe the energy conservation measures acquired and installed, contain a final estimated simple payback period for each measure and the project as a whole, and include a statement that the completed energy conservation measures conform to the approved grant application.

(iii) Grantees shall submit annual energy use reports. Two copies shall be submitted to the State within 60 days of the close of each 12-month period following project completion for a period of three years, or for the life of this Federal program, whichever is shorter, and shall identify each building and provide data on energy use for that building for the preceding 12-month period.

(3) For State administrative grants, each State shall submit a semi-annual program performance report to DOE by the close of each February and August. The report will provide:

(i) A discussion of administrative activities pursuant to § 455.83(c), and a discussion of milestones accomplished, those not accomplished, status of in-progress activities, problems encountered, and remedial actions, if any, planned pursuant to § 455.73(f);

(ii) A summary of grantee reports received by the State during the report period pursuant to paragraphs (b)(1) and (b)(2) of this section; and

(iii) For the report due to be submitted to DOE by the close of each August, an estimate of annual energy use reductions in the State, by energy source, attributable to implementation of energy conservation maintenance and operating procedure and installation of energy conservation measures under this program. Such estimates shall be based upon a sampling of institutions participating in the technical assistance phase of this program and upon the reports submitted to the State pursuant to paragraph (b)(2)(iii) of this section.

(4) Such other information as the Secretary may, from time to time request.

(5) Each copy of any technical assistance, energy conservation measures, or State administrative report shall be accomplished by a financial status report completed in accordance with the documents listed in § 455.3. A financial status report shall not be required for annual reports submitted pursuant to paragraph (b)(2)(iii) of this section. In addition, States shall file quarterly financial status reports for the quarters which occurs between the semi-annual report periods covered in their program performance reports. These quarterly reports are due within 30 days following the end of the applicable quarters.

(6) Grantee technical assistance, energy conservation measure, and financial status reports submitted to the State shall be submitted by the State to DOE as required by the Secretary.

Subpart F—State Responsibilities

§ 455.70 State evaluation of grant applications.

(a) If an application received by a State is reviewed and evaluated by that State and determined to be in compliance with Subparts C, D and E of this part, § 455.70(b), any additional requirements of the approved State Plan, State environmental laws, and other applicable laws and regulations, then such application will be eligible for financial assistance.

(b) Concurrently with its evaluation and ranking of grant applications pursuant to § 455.71, the State will forward applications for technical assistance or for energy conservation measures for a school or hospital to the State school facilities agency or the State hospital facilities agency, as the case may be, for review and certification that each school application is consistent with related State programs for educational facilities, and each hospital application is consistent with State health plans under sections 1524(c)(2) and 1603 of the Public Health Service Act (42 U.S.C. 300m-3 and 300o-2, respectively), and that each has been coordinated through abbreviated review mechanisms under section 1523 of the Public Health Service Act (42 U.S.C. 300m-2) and section 1122 of the Social Security Act. No application from a school or hospital shall be eligible for funding until such certification has been issued.

§ 455.71 State ranking of grant applications.

All eligible applications received by the State will be ranked by the State in accordance with its approved State Plan.

(a) For technical assistance programs, buildings shall be ranked in descending priority based upon the energy conservation potential of the building as determined from an energy audit, its equivalent, or an energy use evaluation if an energy audit has not been performed, in accordance with the procedures established in the State Plan and one or more of the methods indicated in § 455.19(c) or § 455.20(d). In the case of buildings having equivalent energy conservation potential, preference shall be given to those buildings which have completed an energy audit or evaluation without the use of Federal funds. Each State shall develop separate rankings for all buildings covered by eligible applications for—

(1) Technical assistance programs for units of local government and public care institutions, and

(2) Technical assistance programs for schools and hospitals.

(b) All eligible applications for energy conservation measures received will be ranked by the State on an individual building-by-building or a measure-by-measure basis. Several buildings may be ranked as a single building if the application proposes a single energy conservation measure which directly involves all of the buildings. Buildings or measures shall be ranked in accordance with the procedures established by the State Plan, on the basis of the information developed during a technical assistance program (or its equivalent) for the building and the criteria for ranking applications which are listed below in the descending order in which weights for each criterion are to be applied by the State—

(1) Payback, calculated in accordance with § 455.42(d)(5)(vii);

(2) The types of energy sources to which conversion is proposed, including in descending priority—

(i) Renewable; and

(ii) Coal;

(3) The types and quantities of energy to be saved, including oil, natural gas, or electricity, in a priority as established in the approved State Plan;

(4) The quality of the technical assistance program report; and

(5) Other factors as determined by the State.

(c) A State is exempt from the ranking requirements of this section when—

(1) The total amount requested by all applications for schools and hospitals for technical assistance and energy conservation measures in a given grant program cycle for grants up to 50 percent is less than or equal to the funds available to the State for such grants and the total amount recommended for hardship funding is less than or equal to the amounts available to the State for such grants.

(2) The total amount requested by all applications for buildings owned by units of local government and public care institutions in a given grant program cycle is less than or equal to the total amount allocated to the State for technical assistance program grants in the State.

(d) Within the rankings of school and hospital buildings for technical assistance and energy conservation measures, including renewable resource measures, to the extent that approvable applications are submitted, a State shall initially assure that—

(1) Schools receive at least 30 percent of the total funds allocated for schools and hospitals to the State in any grant program cycle; and

(2) Hospitals receive at least 30 percent of the total funds allocated for schools and hospitals to the State in any grant program cycle.

(e) To the extent provided in § 455.100(d), financial assistance will be initially available for schools and hospitals experiencing severe hardship based upon an applicant's long-term need or inability to provide the 50 percent non-Federal share. This financial assistance will be available only to the extent necessary to enable such institutions to participate in the program.

(1) The State shall recommend funds for severe hardship applications wholly or partially from the funds reserved in accordance with § 455.100(d) and as stated in an approved State Plan.

(2) Applications for Federal funding in excess of 50 percent based on claims of severe hardship shall be given an additional evaluation by the State to assess on a quantifiable basis, to the maximum extent practicable, the relative need among eligible institutions. The minimum amount of additional Federal funding necessary for the applicant to participate in the program will be determined by the State in accordance with the procedures established in the State Plan and will be based upon one or more of the following—

(i) The ratio of the cost of the proposed technical assistance programs or energy conservation measures to the institution's total annual budget;

(ii) The borrowing capacity of the institution;

(iii) The average unemployment rate for the institution's locality at the time the application is submitted;

(iv) The ratio of the amount expended annually by the institution for energy to the institution's total annual operating budget;

(v) The median annual family income of the institution's locality; and

(vi) Other special conditions of the institution or its locality as determined by the State.

(3) A State shall indicate, for those schools and hospitals with the highest rankings, determined pursuant to paragraphs (a) and (b) of this section—

(i) The amount of additional hardship funding requested by each eligible applicant for each building determined to be in a class of severe hardship; and

(ii) The amount of hardship funding recommended by the State based upon relative need as determined in accordance with the State Plan, to the limit of the hardship funds available.

(f) Only schools, hospitals, and hardship applicants shall be recommended for funding from the appropriate allocation specified in paragraphs (d) and (e) of this section, unless after the State deadline for submitting applications has passed, there are insufficient applications meeting the requirements of paragraphs (d) and (e) of this section and otherwise qualifying for funding under this part, in which case the State may recommend use of the remaining funds in those allocations to fund applications under this part without regard to the limitations of paragraphs (d) and (e) of this section.

§ 455.72 Forwarding of applications.

(a) Each State shall forward all applications recommended for funding within its allocation to the Secretary once each grant program cycle along with a listing of buildings or measures covered by eligible applications for schools, hospitals, units of local government and public care institutions, and ranked by the State pursuant to the provisions of § 455.71. If ranking has been employed the list shall include the standings of buildings or measures.

(1) Measure by measure rankings will be recombined for the respective building with more than one recommended measure.

(2) Buildings will be consolidated under one grantee application.

(b) The State shall indicate the amount of financial assistance requested by the applicant for each eligible building and, for those buildings recommended for funding within the limits of the State's allocation, the amount recommended for funding. If the amount recommended is less than the amount requested by the applicant, the list shall also indicate the reason for that recommendation.

(c) States shall certify applications submitted are eligible pursuant to § 455.70(a).

§ 455.73 State liaison, monitoring and reporting.

Each State shall be responsible for—

(a) Consulting with eligible institutions and coordinating agencies representing such institutions in the development of its State Plan;

(b) Notifying eligible institutions and coordinating agencies of the content of the approved State Plan and any amendment to a State Plan;

(c) Notifying each applicant how the applicant's building or measure ranked among other applications, and whether and to what extent its application will be recommended for funding or, if not to be recommended for funding, the specific reason(s) therefor;

(d) Certifying that each institution has given its assurance that it is willing and able to participate on the basis of any changes in amounts recommended for that institution in the State ranking pursuant to § 455.71;

(e) Reporting requirements pursuant to § 455.63(b)(3); and

(f) Direct program oversight and monitoring of the activities for which grants are awarded as defined in the State Plan. States shall immediately notify the Secretary of any non-compliance or indication thereof.

Subpart G—Grant Awards

§ 455.80 Approval of grant applications.

(a) The Secretary shall review and approve applications submitted by a State in accordance with § 455.72 if the Secretary determines that the applications meet the objectives of the Act, and comply with the applicable State Plan and the requirements of this part. The Secretary may disapprove all or any portion of an application to the extent funds are not available to carry out a program or measure (or portion thereof) contained in the application, or for such other reason as the Secretary may deem appropriate.

(b) The Secretary shall notify a State and the applicant of the final approval or disapproval of an application at the earliest practicable date after the Secretary's receipt of the application, and, in the event of disapproval, shall include a statement of the reasons therefor.

(c) An application which has been disapproved for reasons other than lack of funds may be amended to correct the cause of its disapproval and resubmitted in the same manner as the original application at any time within the same grant program cycle. Such an application will be considered to the extent funds have not already been designated for institutions by the ranking process at the time of resubmittal. However, nothing in this provision shall obligate either the State or the Secretary to take final action regarding a resubmitted application within the grant program cycle. An application not acted upon may be resubmitted in a subsequent grant program cycle.

(d) The Secretary shall not provide supplemental funds beyond those awarded for technical assistance projects and shall fund only one technical assistance project per building.

(e) The Secretary shall not provide supplemental funds beyond those awarded for all energy conservation measures funded under a grant in a given grant program cycle. An institution may apply for, and the Secretary may make, grant awards in another grant program cycle for energy conservation measures for which financial assistance was not previously and specifically provided, even though the measures relate to a building which previously received grants for other energy conservation measures.

(f) The Secretary may fund costs incurred by an institution for technical assistance and energy conservation measure projects after the date of the grant application, so long as that date is no earlier than the close of the preceding grant program cycle. Such costs may be funded when, in the judgment of the Secretary, the institution has complied with program requirements and the costs incurred are allowable under applicable cost principles and the approved project budget. The applicant bears the responsibility for the entire project cost unless the application is approved by the Secretary in accordance with this part.

(g) In addition to the prior approval requirements for project changes as specified in the DOE Financial Assistance Rules (10 CFR 600.114(c)), a grantee shall request prior written approval from DOE before—

(1) Transferring DOE or matching amounts between buildings included in an approved application when the State ranks applications on a building-by-building basis, or

(2) Transferring DOE or matching amounts between energy conservation measures included in an approved application when the State ranks on a measure-by-measure basis.

§ 455.81 Grant awards for units of local government and public care institutions.

(a) The Secretary may make grants to units of local government, public care institutions and coordinating agencies for up to 50 percent of the costs of performing technical assistance programs for buildings covered by an application approved in accordance with § 455.80; except that in the case of units of local government and public care institutions a majority of whose operating and capital funds are provided by the government of the Virgin Islands, Guam, American Samoa, or the Commonwealth of Northern Mariana Islands, a grant may be made for up to 100 percent of such costs.

(b) Total grant awards within any State to units of local government and public care institutions are limited to funds allocated to each State in accordance with Subpart I of this part.

(c) Units of local government and public care institutions are not eligible for financial assistance for severe hardship.

(d) No grant awarded under this section for a technical assistance program shall include funding for the purchase of any single item of equipment or tangible personal property having an acquisition cost in excess of $500.

§ 455.82 Grant awards for schools and hospitals.

(a) The Secretary may make grants to schools, hospitals and coordinating agencies for up to 50 percent of the costs of performing technical assistance programs for buildings covered by an application approved in accordance with § 455.80; except that in the case of schools and hospitals a majority of whose operating and capital funds are provided by the government of the Virgin Islands, Guam, American Samoa, or the Commonwealth of the

Northern Mariana Islands a grant may be made for up to 100 percent of such costs. Grant awards for technical assistance programs in any State within any grant program cycle shall be limited to a portion of the total allocation as specified in the Subpart I.

(b) The Secretary may make grants to schools, hospitals and coordinating agencies for up to 50 percent of the costs of acquiring and installating energy conservation measures, including renewable resource measures, for buildings covered by an application approved in accordance with § 455.80; except that in the case of schools and hospitals a majority of whose operating and capital funds are provided by the government of the Virgin Islands, Guam, American Samoa, or the Commonwealth of the Northern Mariana Islands, a grant may be made for up to 100 percent of such costs.

(c) The Secretary may award up to 10 percent of the total amount allocated to a State for schools and hospitals in a case of severe hardship, ascertained by the State in accordance with the State Plan, for buildings recommended and in amounts determined by the State pursuant to § 455.71(e).

(d) No grant awarded under this section for a technical assistance program shall include funding for the purchase of any single item of equipment or other tangible personal property having an acquisition cost in excess of $500.

(e) Applicant expenditures for a technical assistance program or installation or one of more energy conservation measures commenced after November 8, 1978 for a building may be wholly or partially credited, in the discretion of the Secretary, toward meeting the matching non-Federal funds requirement for a grant for additional energy conservation measures in the same building. Credit will be considered only when the projects for which credit is sought meet program requirements, except that the project need not comply with the Davis-Bacon Act regarding labor standards or wage rates. Credit for energy conservation measures will be considered only when supported by a technical assistance analysis performed prior to the installation of the energy conservation measures. Applications for credit for completed or partially completed energy conservation measures will be considered in conjunction with applications for additional energy conservation measures. The application shall reflect both the work done and the work to be done and will be reviewed and ranked on that basis. In no case shall the credit exceed an amount equal to the non-Federal share of the proposed additional energy conservation measures.

§ 455.83 Grant awards for State administrative expenses.

(a) For the purpose of defraying State expenses in the administration of technical assistance programs in accordance with Subpart C and energy conservation measures in accordance with Subpart D, the Secretary may make grant awards to a State—

(1) Immediately following public notice of the amounts allocated to a State for the grant program cycle, and upon approval of the application for administrative costs, in an amount not exceeding $30,000 or 2 percent of that State's allocation for a given grant program cycle for technical assistance and energy conservation measures, whichever is higher. Grants for such purposes may be made for up to 50 percent of a State's projected administrative expenses, or in the case of grants to the Virgin Islands, Guam, American Samoa, and the Commonwealth of the Northern Mariana Islands, for up to 100 percent of the projected administrative expenses, as approved by the Secretary; and

(2) Concurrently with grant awards for approved applications for technical assistance or energy conservation measures for institutions in that State, and upon approval of an application for administrative costs, in an amount not exceeding the difference between the amount granted pursuant to paragraph (a)(1) of this section and 5 percent of the total amount of grants awarded within the State for technical assistance programs and energy conservation measures in the applicable grant program cycle. Grants for such purposes may be made for up to 50 percent of a State's projected adminis-

trative expenses or in the case of grants to the Virgin Islands, Guam, American Samoa, and the Commonwealth of the Northern Mariana Islands, for up to 100 percent of the projected administrative expenses, as approved by the Secretary. The total of all grants for State administrative costs, technical assistance programs and energy conservation measures in that State shall not exceed the total amount allocated for that State for any grant program cycle.

(b) In the event that a State cannot or decides not to use the amount available to it for an administrative grant under this section for administrative purposes, these funds may, at the discretion of the State, be used for technical assistance and energy conservation grants to eligible institutions within that State in accordance with this part.

(c) A State's administrative expenses shall be limited to those directly related to administration of technical assistance programs and energy conservation measures including costs associated with—

(1) Personnel, whose time is expended directly in support of such administration;

(2) Supplies, and services, expended directly in support of such administration;

(3) Equipment purchased or acquired solely for, and utilized directly in support of such administration, provided that no single item of equipment or other tangible personal property costing more than $500 shall be acquired without the prior written approval of DOE;

(4) Printing, directly in support of such administration; and

(5) Travel, directly related to such administration.

Subpart H—State Plan Development and Approval

§ 455.90 Contents of State plan.

Each State shall develop a State Plan for technical assistance programs and energy conservation measures, including renewable resource measures. The State Plan shall include—

(a) A statement setting forth the procedures by which the views of eligible institutions or coordinating agencies representing such institutions, or both, were solicited and considered during development of the State Plan, and any amendment to a State Plan;

(b) The procedures the State will follow to notify eligible institutions and coordinating agencies of the content of the approved State Plan, or any approved amendment to a State Plan;

(c) The procedures for submittal of grant applications to the State;

(d) A description and evaluation of the results of preliminary energy audits (described in Subpart B of this part) which have been conducted in the State including, but not limited to—

(1) In the case of a State which has completed preliminary energy audits of all potentially eligible buildings, a summary of the data gathered pursuant to § 455.18 for all such buildings;

(2) In the case of a State which has completed preliminary energy audits of a sample of all potentially eligible buildings within the State—

(i) Reasonably accurate estimates of the preliminary energy audit data required by § 455.18 for all potentially eligible buildings within the State; and

(ii) A plan which describes further actions to be taken to complete preliminary energy audits of all potentially eligible buildings;

(e) The procedures to be used by the State for evaluating and ranking technical assistance and energy conservation measure grant applications pursuant to § 455.71, including the weights assigned to each criterion set forth in § 455.71(b). In addition, the State shall determine the order of priority given to fuel types that include oil, natural gas, and electricity, under § 455.71(b)(3).

(f) The procedures that the State will follow to insure that funds will be allocated equitably among eligible applicants within the State, including procedures to insure that funds will not be allocated on the basis of size or type of institution but rather on the basis of relative need taking into account such factors as cost, energy consumption and energy savings, in accordance with § 455.71;

(g) The procedures that the States will follow for identifying schools and hospitals experiencing severe hardship and for apportioning the funds that are available for schools and hospitals in a case of severe hardship. Such policies and procedures shall be in accordance with § 455.71(e);

(h) A statement setting forth the extent to which, and by which methods, the State will encourage utilization of solar space heating, cooling and electric systems and solar water heating systems;

(i) The procedures to assure that all financial assistance under this part will be expended in compliance with the requirements of the State Plan, in compliance with the requirements of this part, and in coordination with other State and Federal energy conservation programs;

(j) The procedures to insure implementation of energy conservation maintenance and operating procedures in those buildings for which financial assistance is requested under this part. At a minimum, the plan shall provide all maintenance and operating procedure changes recommended in an energy audit report, the equivalent of an energy audit report, an energy use evaluation, a technical assistance report, or a combination of these that have been implemented as provided under this part. An assurance that the maintenance and operating procedures will be implemented in the future, or a justification for not implementing such a procedure, as appropriate, may be acceptable in lieu of implementation if it is shown that—

(1) The recommendation is infeasible because of factors not considered by the auditor or analyst;

(2) There is a cost involved which exceeds the institution's limit in operating expenditures, provided it is shown a budget request has been made to implement the recommendation, and assurance is given that the change will be effected at some specified future date;

(3) The implementation of the change requires some item of supply or material which is not presently available; or

(4) Other factors subject to approval by the Secretary on a case-by-case basis;

(k) The procedures designed to insure that financial assistance under this part will be used to supplement, and not to supplant, State, local or other funds;

(l) The circumstances under which the State will accept an energy use evaluation in lieu of an energy audit, and the information the State will require to be contained in that evaluation;

(m) The procedures for determining that energy audits performed without the use of Federal funds have been performed in substantial compliance with the eligibility requirements contained in § 455.41(c);

(n) The procedures for determining that technical assistance programs performed without the use of Federal funds have been performed in compliance with the requirements of § 455.42, for the purposes of satisfying the eligibility requirements contained in § 455.51(a)(3);

(o) The procedures for State management, monitoring and evaluation of technical assistance programs and energy conservation measures receiving financial assistance under this part;

(p) A description of the State's program for establishing and insuring compliance with qualifications for technical assistance analysts. Such policies shall require that technical assistance analysts have experience in energy conservation and—

(1) Be a registered professional engineer licensed under the regulatory authority of the State;

(2) Be an architect-engineer team, the principal members of which are licensed under the regulatory authority of the State; or

(3) Be otherwise qualified in accordance with such criteria as the State may prescribe in its State Plan to insure that individuals conducting technical assistance programs possess the appropriate training and experience in building energy systems. Such policies shall also require that technical assistance analysts be free from financial interests which may conflict

with the proper performance of their duties;

(q) A statement setting forth—

(1) An estimate of energy savings which may result from the modification of maintenance and operating procedures and installation of energy conservation measures;

(2) A recommendation as to the types of energy conservation measures considered appropriate within the State; and

(3) An estimate of the costs of carrying out technical assistance and energy conservation measures programs; and

(r) For purposes of the technical assistance program, § 455.42, a statement setting forth uniform conversion factors to be used in the technical assistance analysis for conversion of fuels to Btu equivalents.

§ 455.91 Submission and approval of State plans.

(a) Proposed State Plans or amendments necessitated by a change in regulations shall be submitted to the Secretary within 90 days of the effective date of this subpart or any amended regulations. The Secretary, upon request and for good cause shown, may grant an extension of time.

(b) The Secretary shall, within 60 days of receipt of a proposed State Plan, review each plan and, if it is found to conform to the requirements of this part, approve the State Plan. If the Secretary does not disapprove a State Plan within the 60-day period, the Secretary will be deemed to have approved the State Plan.

(c) If the Secretary determines that a proposed State Plan fails to comply with the requirements of this part the Secretary shall return the plan to the State with a statement setting forth the reasons for disapproval.

(d) The Secretary shall review each amendment submitted by the State and, if it is found to conform to the requirements of this part, approve the amendment. If the Secretary determines that a proposed State Plan amendment fails to comply with the requirements of this part, the Secretary shall return the amendment to the State with a statement setting forth the reasons for disapproval. With the consent of the Secretary, the State may submit a new or amended plan at any time.

§ 455.92 State plans developed by the Secretary.

(a) If a State Plan has not been approved by February 7, 1981, or within 90 days after completion of the preliminary energy audits, whichever is later, the Secretary may develop and implement a State Plan on behalf of the schools and hospitals in the State.

(b) Subsequent to the development of a State Plan by the Secretary, the State may submit its own State Plan and the Secretary shall approve or disapprove such plan within 60 days after receipt by the Secretary. If the proposed plan meets the requirements of this part, and is not inconsistent with any plan developed and implemented by the Secretary, the Secretary shall approve the State Plan which shall automatically replace the plan developed by the Secretary.

Subpart I—Allocation of Appropriations Among the States

§ 455.100 Allocation of funds.

(a) The Secretary will allocate available funds among the States for the purpose of awarding grants to schools, hospitals, units of local government, and public care institutions and coordinating agencies to implement technical assistance and energy conservation measures grant programs in accordance with this part.

(b) The Secretary shall notify each Governor of the total amount allocated for grants within the State for any grant program cycle—

(1) For schools and hospitals, the allocation amount shall be for technical assistance programs, together with any limitation placed on technical assistance, and energy conservation measures; and

(2) For units of local government and public care institutions, the allocation amount shall be solely for technical assistance programs.

(c) The Secretary shall notify each Governor of the period for which funds allocated for a grant program cycle will be made available for grants within the State.

(d) Each State shall make available up to 10 percent of its allocation for schools and hospitals in each grant program cycle to provide financial assistance, not to exceed a 90 percent Federal share, for technical assistance programs and energy conservation measures for schools and hospitals determined to be in a class of severe hardship. Such determinations shall be made in accordance with § 455.71(e).

§ 455.101 Allocation formulas.

(a) Financial assistance for conducting technical assistance programs for units of local government and public care institutions shall be allocated among the States by multiplying the sum available by the allocation factor set forth in paragraph (c) of this section.

(b) Financial assistance for conducting technical assistance programs and acquiring and installing energy conservation measures including renewable resource measures, shall be allocated among the States by multiplying the sum available by the allocation factor set forth in paragraph (c) of this section.

(c) The allocation factor (K) shall be determined by the formula—

$$K = \frac{0.07}{N} + 0.1\,\frac{(Sfc)}{(Nfc)} + 0.83\,\frac{(SP)(SC)}{(NPC)}$$

where, as determined by DOE—

(1) Sfc is the projected average retail cost per million Btu's of energy consumed within the region in which the State is located, as contained in current regional energy cost projections obtained from the Energy Information Administration.

(2) Nfc is the summation of the Sfc numerators for all States;

(3) N is the total number of eligible States;

(4) SP is the population of the State, as contained in the most recent Bureau of the Census, Department of Commerce, Official Census documents;

(5) SC is the sum of the State's heating and cooling degree days, as contained in the National Oceanic and Atmospheric Administration's most recent editions of "State, Regional and National Monthly and Seasonal Heating Degree Days, Weighted by Population;" and "State, Regional and National Monthly and Seasonal Cooling Degree Days, Weighted by Population;" and

(6) NPC is the summation of the (SP)(SC) numerators for all States.

(d) Except for the District of Columbia, Puerto Rico, Guam, American Samoa, the Commonwealth of the Northern Mariana Islands, and the Virgin Islands, no allocation available to any State may be less than 0.5 percent of all amounts allocated in any grant program cycle. No State will be allocated more than 10 percent of the funds allocated in any grant program cycle.

§ 455.102 Reallocation of funds.

(a) If a State Plan has not been approved and implemented by a State by the close of the period for which allocated funds are available as set forth in the notice issued by the Secretary pursuant to § 455.100(c), funds allocated to that State for technical assistance and energy conservation measures will be reallocated among all States for the next grant program cycle, if available.

(b) If a State Plan has not been approved by February 7, 1981, or within 90 days after completion of the preliminary energy audits, whichever is later, the Secretary may develop and implement a State Plan on behalf of the schools and hospitals within the State. If the Secretary does not develop a State Plan for a State, the funds reserved for that grant program cycle for schools and hospitals in that State will be reallocated for the next grant program cycle among all States for schools and hospitals.

(c) The Secretary shall reallocate the funds which remain unobligated by DOE at the end of any grant program cycle among all States in the next grant program cycle.

Subpart J—Administrative Review

§ 455.110 Right to administrative review.

(a) A State shall have a right to file a notice requesting administrative review of a decision under § 455.83 by an Operations Office Manager to disapprove an application for a grant award for State administrative expenses subject to special conditions or a decision under § 455.91 of this part by an Operations Office Manager to disapprove a State plan or an amendment to a State plan.

(c) A school, hospital, coordinating agency or State acting as an institution's duly authorized agent shall have a right to file a notice requesting administrative review of a decision under § 455.82 by an Operations Office Manager to disapprove an application for a grant award to perform technical assistance programs or to acquire and install an energy conservation measure if the disapproval is based on a determination that—

(1) The applicant is ineligible, under § 455.41 or § 455.51 or for any other reason;

(2) An energy use evaluation submitted in lieu of an energy audit, pursuant to § 455.20, is unacceptable under the State plan; or

(3) A technical assistance program equivalent performed without the use of Federal funds does not comply with the requirements of § 455.42 for purposes of satisfying the eligibility requirements of § 455.51(a)(3).

§ 455.111 Notice requesting administrative review.

(a) Any applicant shall have 20 days from the date of receipt of a decision under § 455.110 to disapprove its application for a grant award to file a notice requesting administrative review. If an applicant does not timely file such a notice, the decision to disapprove shall become final for DOE.

(b) A notice requesting administrative review shall be filed with the Operations Office Manager and shall be accompanied by a written statement containing supporting arguments.

(c) If the applicant is a State appealing pursuant to paragraph (a) of § 455.110, the State shall have the right to a public hearing. To exercise that right, the State must request such a hearing in the notice filed under paragraph (b) of this section. A public hearing under this section shall be informal and legislative in nature.

(d) A notice or any other document shall be deemed filed under this subpart upon receipt.

§ 455.112 Transmittal of record on review.

On or before 15 days from receipt of a notice requesting administrative review which is timely filed, the Operations Office Manager shall forward to the Deputy Assistant Secretary, the notice requesting administrative review, the decision to disapprove as to which administrative review is sought, a draft recommended final decision for concurrence, and any other relevant material.

§ 455.113 Review by the Deputy Assistant Secretary.

(a) If a State requests a public hearing pursuant to paragraph (a) of § 455.110, the Deputy Assistant Secretary, within 15 days, shall give actual notice to the State and FEDERAL REGISTER notice of the date, place, time, and procedures which shall apply to the public hearing. Any public hearing under this section shall be informal and legislative in nature.

(b) The Deputy Assistant Secretary shall concur in, concur in as modified, or issue a substitute for the recommended decision of the Operations Office Manager—

(1) With respect to a notice filed pursuant to paragraph (a) of § 455.110, on or before 60 days from receipt of documents under § 455.112 or the conclusion of a public hearing, whichever is later; or

(2) With respect to a notice filed pursuant to paragraph (b) of § 455.110, on or before 30 days from receipt of documents under § 455.112.

§ 455.114 Discretionary review by the Assistant Secretary.

On or before 15 days from the date of receipt of the determination under § 455.113(b), the applicant for a grant award may file an application, with a supporting statement of reasons, for discretionary review by the Assistant Secretary. If administrative review is sought pursuant to paragraph (a) of § 455.110, the Assistant Secretary shall send a notice granting or denying discretionary review within 15 days and upon granting such review, shall issue a decision no later than 60 days from the date discretionary review is granted. If administrative review is sought pursuant to paragraph (b) of § 455.110, the Assistant Secretary shall send a notice granting or denying discretionary review within 10 days, and upon granting such review shall issue a decision no later than 30 days from the date discretionary review is granted. The Assistant Secretary may not issue a notice or decision under this paragraph without the concurrence of the DOE Office of General Counsel.

§ 455.115 Finality of decision.

A decision under § 455.113 shall be final for DOE if there is no review sought under § 455.114. If there is review under § 455.114, the decision thereunder shall be final for DOE, and no appeal shall lie elsewhere in DOE.

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APPENDIX III TO PART 456—MULTIFAMILY APPLICABILITY CRITERIA AND PROCEDURES FOR DETERMINING USAGE CUTOFF LEVELS

AUTHORITY: Part 1 of Title II of the National Energy Conservation Policy Act, Pub. L. 95-619, 92 Stat. 3206 et seq. (42 U.S.C. 8211 et seq.), as amended by Title V, Subtitle B of the Energy Security Act, Pub. L. 96-294, 94 Stat. 611 et seq. and of the Conservation Service Reform Act of 1986, Pub. L. 99-412; Department of Energy Organization Act, Pub. L. 95-91, 91 Stat. 565 et seq. (42 U.S.C. 7101 et seq.).

SOURCE: 52 FR 34143, Sept. 9, 1987, unless otherwise noted.

Subpart A—General Provisions and Definitions

§ 456.101 Purpose and scope.

This part contains the regulations of the Energy Conservation Service Program. This program is mandated by Titles II and VII of the National Energy Conservation Policy Act (NECPA), Pub. L. 95-619 as amended by Subtitle B of Title V of the Energy Security Act (ESA), Pub. L. 96-294, and by Title I of the Conservation Service Reform Act of 1986 (CSRA), Pub. L. 99-412.

§ 456.102 Petitions concerning conflicts of laws.

(a) A utility filing a petition to determine whether the utility—

(1) Is prohibited by a State or local law or regulation from taking any action required to be taken under NECPA, or

(2) Is required or permitted by a State or local law or regulation to take any action prohibited by NECPA, shall file the petition with the Assistant Secretary for Conservation and Renewable Energy, Department of Energy, 1000 Independence Avenue, SW., Washington, DC 20585. Any such petition shall contain a copy of the applicable State or local laws or regulations and a description of the action the utility believes it is prohibited from taking or is permitted or required to take under such laws or regulations.

(b) The Assistant Secretary shall give notice of the petition to the Governor, State Energy Office, and State Regulatory Authority of the applicable State, and such other persons as the Assistant Secretary deems appropriate. Any such person or entity may file comments with the Assistant Secretary with respect to such petition within 30 days of receipt of the notice.

(c) If the Assistant Secretary determines pursuant to such petition that a State or local law or regulation prohibits a utility from taking any action required to be taken under NECPA or permits or requires a utility to take any action prohibited by NECPA, the Assistant Secretary shall issue an order superseding such State or local laws or regulations to the extent the laws or regulations are inconsistent with NECPA. Such an order shall be effective with respect to all utilities otherwise subject to such State or local laws or regulations and shall moot any outstanding petitions under this section by such utilities.

§ 456.103 Appeals and other relief.

(a) Any person seeking relief from the application of this rule, except from Subparts K, L, and M of this part may submit a request for relief in accordance with Subpart R of 10 CFR Part 205. When applicable, such a request shall contain the approval of the Governor.

(b) Any person aggrieved by any order, finding, or determination made under §§ 456.102, 456.502–456.505, or 456.507 may appeal that order, finding, or determination in accordance with Subpart H of 10 CFR Part 205. Any person so aggrieved has not exhausted his administrative remedies until an appeal has been filed under Subpart H of 10 CFR Part 205 and an order granting or denying the appeal has been issued.

§ 456.104 List of covered utilities.

(a) Before the beginning of each calendar year, the Department of Energy shall publish in the FEDERAL REGISTER a list of all covered utilities for that calendar year.

(b) Not later than 60 days after publication of the list, each State Regulatory Authority shall forward to the Assistant Secretary a copy of such list with designations as to which covered utilities on the list are under the jurisdiction of that Regulatory Authority.

(c) The publication of the list is for informational purposes, and the failure to include a covered utility on the list or the failure of a State Regulatory Authority to designate a covered utility subject to its jurisdiction in no way affects the duties of or requirements upon such covered utility under these rules or any plan promulgated pursuant to these rules.

§ 456.105 Definitions.

For purposes of this part—

(a) *Alternative State Plan.* The term "alternative State plan" means a plan developed pursuant to Subpart K of this part.

(b) *Assistant Secretary.* The term "Assistant Secretary" means the Assistant Secretary for Conservation and Renewable Energy of the U.S. Department of Energy.

(c) *Covered Utility.* The term "covered utility" means in any calendar year a public utility which during the second preceding calendar year had either—

(1) Sales of natural gas for purposes other than resale which exceeded 10 billion cubic feet, or

(2) Sales of electric energy for purposes other than resale which exceeded 750 million kilowatt-hours.

(d) *CSRA.* The term "CSRA" means Title I of the Conservation Service Reform Act of 1986, Pub. L. 99-412, which amended Part 1 of Title II of the National Energy Conservation Policy Act (NECPA).

(e) *Eligible Customer.* The term "eligible customer" means a person who owns or occupies a residential building or dwelling unit therein and receives a bill or bills based on individually metered energy use from a covered utility or participating home heating supplier for energy used in such residential building or individual dwelling unit, except that—

(1) The owner of the common area within a residential building containing five or more dwelling units shall not be treated as an eligible customer for the purpose of the common area; and

(2) This definition shall not apply to any building which has five or more dwelling units and which does not contain an individual meter for heating or cooling energy sources used in such dwelling unit.

(f) *Energy Conservation Measures.* The term "energy conservation measures" means the following measures in a residential building—

(1) *Caulking.* The term "caulking" means pliable materials used to reduce the passage of air and moisture by filling small gaps which may include (i) at fixed joints on a building, (ii) under baseboards inside a building, (iii) in exterior walls at electric outlets, (iv) around pipes and wires entering a building, and (v) around dryer vents and exhaust fans in exterior walls. Caulking includes, but is not limited to, materials commonly known as "sealants," "putty," and "glazing compounds."

(2) *Weatherstripping.* The term "weatherstripping" means narrow strips of material placed over or in movable joints of windows and doors to reduce the passage of air and moisture.

(3) *Furnace Efficiency Modifications.* The term "furnace efficiency modification" means—

(i) *Replacement Furnaces or Boilers.* The term "replacement furnaces or boilers" means a furnace or boiler, including a heat pump, which replaces an existing furnace or boiler of the same fuel type and which reduces the amount of fuel consumed due to an increase in combustion efficiency, improved heat generation, or reduced heat losses.

(ii) *Furnace Replacement Burner (Oil).* The term "furnace replacement burner (oil)" means a device which atomizes the fuel oil, mixes it with air, and ignites the fuel-air mixture, and is an integral part of an oil-fired furnace or boiler including the combustion chamber, and which, because of its design, achieves a reduction in the oil used from that used by the device which it replaces.

(iii) *Flue Opening Modification (Vent Damper).* The term "flue opening modification (vent damper)" means an automatically operated damper installed in a gas-fired furnace which—

(A) Is installed downstream from the drafthood; and

(B) Conserves energy by substantially reducing the flow of heated air through the chimney when the furnace is not in operation.

(iv) *Intermittent Pilot Ignition Devices (IID).* The term "intermittent pilot ignition device (IID)" means a device which, when installed in a gas-fired furnace or boiler, automatically ignites the gas burner and replaces a gas pilot light.

(4) *Replacement Central Air Conditioner.* The term "replacement central air conditioner" means a central air conditioner which replaces an existing central air conditioner of the same fuel type and which reduces the amount of fuel consumed due to an increase in efficiency.

(5) *Ceiling Insulation.* The term "ceiling insulation" means a material, primarily designed to resist heat flow, which is installed between the conditioned area of a building and an unconditioned attic. Where the conditioned area of a building extends to the roof, the term "ceiling insulation" also applies to such material used between the underside and upperside of the roof. The term "ceiling insulation" also includes such material installed on the exterior of the roof.

(6) *Wall Insulation.* The term "wall insulation" means a material, primarily designed to resist heat flow, which is installed within or on the walls between conditioned areas of a building and unconditioned areas of a building or the outside.

(7) *Floor Insulation.* The term "floor insulation" means a material, primarily designed to resist heat flow which is installed between the first level conditioned area of a building and an unconditioned basement, a crawl space, or the outside beneath it. Where the first level conditioned area of a building is on a ground level concrete slab, the term "floor insulation" also means such material installed around the perimeter of or on the slab. In the case of mobile homes, the term "floor insulation" also means skirting to enclose the space between the building and the ground.

(8) *Duct Insulation.* The term "duct insulation" means a material, primarily designed to resist heat flow, which is installed on a heating or cooling duct in an unconditioned area of a building.

(9) *Pipe Insulation.* The term "pipe insulation" means a material, primarily designed to resist heat flow, which is installed on a heating or cooling pipe in an unconditioned area of a building.

(10) *Water Heater Insulation.* The term "water heater insulation" means a material, primarily designed to resist heat flow, which is suitable for wrapping around the exterior surface of the water heater casing.

(11) *Storm Window.* The term "storm window" means a window or glazing material placed outside or inside an ordinary or prime window, creating an air space, to provide greater resistance to heat flow than the prime window alone.

(12) *Thermal Window.* The term "thermal window" means a window unit with improved thermal performance through the use of two or more sheets of glazing material affixed to a window frame to create one or more insulated air spaces. It may also have an insulating frame and sash.

(13) *Storm Door.* The term "storm door" means a second door, installed outside or inside a prime door, creating an insulating air space.

(14) *Thermal Door.* The term thermal door" means—

(i) A door with enhanced resistance to heat flow through the glass area by affixing two or more sheets of glazing material; or

(ii) A prime exterior door with an R-value of at least 2.

(15) *Heat Reflective and Heat Absorbing Window or Door Material.* The term "heat reflective and heat absorbing window or door material" means a window or door glazing material with exceptional heat reflecting or heat absorbing properties; or reflective or absorptive films and coatings applied to an existing window or door which thereby result in exceptional heat reflecting or heat absorbing properties.

(16) *Devices Associated with Electric Load Management Techniques.* The term "devices associated with electric load management techniques" means devices that reduce the maximum kilowatt demand on an electric utility and which are either—

(i) Part of a radio, ripple or other utility controlled load switching system on the customer's premises;

(ii) Clock-controlled load switching devices on major appliances;

(iii) Interlocks, and other load actuated, load-limiting devices; or

(iv) Energy storage devices with control systems.

(17) *Clock Thermostat.* The term "clock thermostat" means a device which is designed to reduce energy consumption by regulating the demand on the heating or cooling system in which it is installed and which uses—

(i) A temperature control device for interior spaces incorporating more than one temperature control level, and

(ii) A clock or other automatic mechanism for switching from one control level to another.

(g) *Energy Conserving Practices.* The term "energy conserving practices" means low or no cost practices designated by the Governor in a State Plan which save energy, do not require the installation of energy conservation or renewable resource measures, and do not adversely impact the RCS Program. Such practices may include, but are not limited to—

(1) Furnace Efficiency Maintenance and Adjustments, which means cleaning and combustion efficiency adjustment of gas or oil furnaces, periodic cleaning or replacement of air filters on forced-air heating or cooling systems, lowering the bonnet or plenum thermostats to 80 °F. on gas or oil forced-air furnaces, and turning off the pilot light on a gas furnace during the summer;

(2) Nighttime Temperature Setback, which means manually lowering the thermostat control setting for the furnace during the heating season to a maximum of 55, during sleeping hours;

(3) Reducing Thermostat Settings in Winter, which means-limiting the maximum thermostat control setting for the furnace to 68 °F. during the heating season;

(4) Raising Thermostat Setting in Summer, which means setting the thermostat control for an air conditioner to 78 °F. or higher during the cooling season;

(5) Water Flow Reduction in Showers and Faucets, which means placing a device in a shower head or faucet to limit the maximum flow to three gallons per minute, or replacing existing shower heads or faucets with those having built-in provisions for limiting the maximum flow to three gallons per minute;

(6) Reducing Hot Water Temperatures, which means manually setting back the water heater thermostat setting to 120 °F., and reducing the use of heated water for clothes washing;

(7) Reducing Energy Use When a Home is Unoccupied, which means reducing the thermostat setting to 55 °F. when a home is empty for four hours or longer in the heating season, turning an air conditioner off in the cooling season when no one is home, and turning a water heater off when a home is vacant for two days or longer;

(8) Plugging Leaks in Attics, Basements, and Fireplaces, which means (i) installing scrap insulation or other pliable materials in gaps around pipes, ducts, fans, or other items which enter the attic or basement from a heated space, (ii) installing fireproof material to plug any holes around any damper in a fireplace, and (iii) adding insulation to an attic or basement door;

(9) Sealing Leaks in Pipes and Ducts, which means installing caulking in any leak in a heating or cooling duct, tightening or plugging any leaking joints in hot water or steam pipes, and replacing washers in leaking water valves; and

(10) Efficient Use of Shading, which means using shades or drapes (i) to block sunlight from entering a building in the cooling season, (ii) to allow sunlight to enter during the heating season, and (iii) to cover windows tightly at night during the heating season.

(h) *ESA.* The term "ESA" means Subtitle B of Title V of the Energy Security Act, Pub. L. 96-294, which amended Part 1 of Title II of the National Energy Conservation Policy Act (NECPA).

(i) *Governor.* The term "Governor" means the Governor or chief executive officer of a State or his designee; or, if a State agency is specifically designated by State law to carry out any function under the RCS Program, then the term "Governor" means that State agency for that function.

(j) *Home Heating Supplier.* The term "home heating supplier" means a person who sells or supplies home heating fuel (including No. 2 heating oil, kerosene, butane, and propane) to an eligible customer for consumption in a residential building.

(k) *Measure Warranties.* (1) The term "manufacturer's measure warranty" means, at a minimum, a written warranty by the manufacturer of an energy conservation or renewable resource measure that the eligible customer for whom the measure is installed, the installation contractor who installs the measure, and the seller of the measure shall be entitled to obtain, within a reasonable period of time and at no charge, appropriate replacement parts or materials for those measures found within one year from the date of installation to be defective due to materials, manufacture, or design;

(2) The term "supplier's measure warranty" means, at a minimum, a written warranty equivalent to that referred to in paragraph (1) of this definition provided by the supplier of an energy conservation or renewable resource measure to persons who purchase the measure from the supplier;

(3) The term "contractor's measure warranty" means, at a minimum, a written warranty by a contractor installing an energy conservation or renewable resource measure that any defect in materials, manufacture, design, or installation found within one year from the date of installation shall be remedied without charge and within a reasonable period of time.

(l) *NECPA.* The term "NECPA" means Part 1 of Title II of the National Energy Conservation Policy Act, Pub. L. 95-619, as amended by Subtitle B of Title V of the Energy Security Act (ESA) and by Title I of the Conservation Service Reform Act of 1986 (CSRA).

(m) *Nonregulated Utility.* The term "nonregulated utility" means a public utility which is not a regulated utility.

(n) *Nonregulated Utility Plan.* The term "nonregulated utility plan" means a plan developed pursuant to Subpart D of this part.

(o) *Participating Home Heating Supplier.* The term "participating home heating supplier" means a home heating supplier that has elected to participate in a State Plan which includes home heating suppliers.

(p) *Program Announcement.* The term "program announcement" means the RCS program information and offer of services required to be provided by a covered utility or participating home heating supplier to each eligible customer by § 456.305.

(q) *Program Audit.* The term "program audit" means an audit in which the estimates of costs and energy savings are based on an adequate assessment, including actual measurements or inspections, as appropriate, performed on-site by the auditor, of the building shell and of the space heating, space cooling, and water heating equipment of the residence of an eligible customer. In the case of residential buildings containing more than four dwelling units, the program audit may mean an audit in which the estimates of costs and energy savings are based on a sampling of the types of units in the building.

(r) *Program Information.* The term "program information" means the program announcement and any information dissemination activities related to an RCS program.

(s) *Program Measures.* The term "program measures" means those energy conservation or renewable resource measures which the Assistant Secretary has by rule determined to be appropriate by climatic region and fuel use category and which are found in Appendix I to this part, or which are determined to be program measures by a Governor in accordance with § 456.315(b).

(t) *Public Utility.* The term "public utility" means any person, State agency, or Federal agency which is engaged in the business of selling natural gas or electric energy, or both to residential customers for use in residential buildings.

(u) *Rate.* The term "rate" means any price, rate, charge, or classification made, demanded, observed, or received with respect to sales of electric energy or natural gas, any rule, regulation, or practice respecting any such rate, charge or classification, and any contract pertaining to the sales of electric energy or natural gas.

(v) *Ratemaking Authority.* The term "ratemaking authority" means authority to fix, modify, approve, or disapprove rates.

(w) *RCS Program.* The term "RCS Program" (Residential Conservation Service Program) means the program required to be implemented by covered utilities pursuant to an approved State Plan, an alternative State plan, an approved Nonregulated Utility Plan, or a Federal Standby Plan.

(x) *Regulated Utility.* The term "regulated utility" means a public utility with respect to whose rates a State regulatory authority has ratemaking authority.

(y) *Renewable Resource Measure.* The term "renewable resource measure" means the following measures in or with respect to a residential building—

(1) *Solar Domestic Hot Water Systems.* The term "solar domestic hot water systems" means equipment designed to absorb the sun's energy and to use this energy to heat water for use in a residential building other than for space heating, including thermostat hot water heaters.

(2) *Active Solar Space Heating Systems.* The term "active solar space heating systems" means equipment designed to absorb the sun's energy and to use this energy to heat living space by use of mechanically forced energy transfer devices, such as fans or pumps.

(3) *Combined Active Solar Space Heating and Solar Domestic Hot Water System.* The term "combined active solar space heating and solar domestic hot water system" means equipment designed to perform both of the functions described in paragraphs (1) and (2) of this definition.

(4) *Wind Energy Devices.* The term "wind energy devices" means equip-

ment that uses wind energy to produce energy in any form for residential purposes.

(5) *Replacement Solor Swimming Pool Heaters.* The term "replacement solar swimming pool heaters" means a device which uses the sun's energy solely for the purpose of heating swimming pool water and which displaces the use of a swimming pool heater using electricity, gas or other fossil fuels.

(z) *Residential Building.* The term "residential building" means any building used for residential occupancy which—

(1) Is not a new building to which final standards under section 304(a) of the Energy Conservation and Production Act apply; and

(2) Has a system for heating or cooling, or both.

(aa) *Secretary.* The term "Secretary" means the Secretary of Energy.

(bb) *State.* The term "State" means a State, the District of Columbia and Puerto Rico.

(cc) *State Agency.* The term "State agency" means a State, a political subdivision thereof, or any agency or instrumentality of either.

(dd) *State Plan.* The term "State Plan" means a plan developed pursuant to Subpart B and C of this part.

(ee) *State Regulatory Authority.* The term "State regulatory authority" means any State agency which has ratemaking authority with respect to the sales of electric energy or natural gas by any public utility (other than by such State agency), except that in the case of a public utility with respect to which the Tennessee Valley Authority has ratemaking authority, such term means the Tennessee Valley Authority.

(ff) *TVA.* The term "TVA" means the Tennessee Valley Authority.

§ 456.106 [Reserved]

§ 456.107 Termination.

Effective June 30, 1989, in accordance with Section 228 of NECPA, all authority, including the authority to enforce any prohibitions, under this part shall terminate, except that such expiration shall not affect any action or proceeding based upon an act committed prior to midnight June 30, 1989, and not finally determined by such date. This section shall not apply to Subpart M of this part

Subpart B—Preparation, Submission, and Approval of State Plans and Temporary Programs

§ 456.201 Scope.

This subpart identifies the responsibilities of the States and the Tennessee Valley Authority (TVA) in the preparation and submission of State Plans; the procedures for approval of the State Plan by the Assistant Secretary; and the procedures for submission and criteria for approval of Temporary Programs.

§ 456.202 Initial submission.

If a State intends to submit a State Plan, the Governor shall submit by January 6, 1980, a list of nonregulated covered utilities, if any, operating in the State which will be subject to the State Plan.

§ 456.203 Notice, comment, and public hearing.

Prior to submission of the State Plan to the Assistant Secretary for approval, the Governor shall provide for meaningful public notice, an opportunity for public comment, and public hearing.

§ 456.204 Procedures for submission and approval of State Plans.

(a) *Who shall submit.* Three (3) copies of the proposed State Plan shall be submitted to the Assistant Secretary by either:

(1) The Governor of the State; or

(2) The TVA with respect to all covered utilities over which the TVA has ratemaking authority and, in the discretion of TVA, with respect to any covered utility over which the TVA and another State Regulatory Authority have ratemaking authority.

(b) *Time for submission.* The proposed State Plan shall be submitted by June 4, 1980, unless the time for submission has been extended by the Assistant Secretary, upon request of the Governor, for good cause shown.

(c) *Approval.* If a proposed State Plan meets the criteria of Subparts B and C of this part, the Assistant Secretary shall approve it within 90 days of the date the proposed State Plan was submitted.

(d) *Disapproval.* (1) If a proposed State Plan does not meet the criteria of Subparts B and C of this part, the Assistant Secretary shall, within 90 days of the date the proposed State Plan was submitted, disapprove the proposed State Plan in writing and shall specify in writing the grounds for disapproval.

(2) Within 60 days of the date of disapproval of a proposed State Plan, or such longer period as the Assistant Secretary may determine, for good cause shown, the Governor may submit another proposed State Plan.

(e) *Amendments.* The Governor may submit proposed amendments to an approved State Plan at any time. The Assistant Secretary shall approve or disapprove a proposed amendment within 90 days of receipt of the proposed amendment.

§ 456.205 Home heating suppliers.

If the Governor submits a plan applicable to home heating suppliers in the State, it shall be a part of the State Plan and shall be submitted in accordance with the procedures of this subpart applicable to the submission of the State Plan.

§ 456.206 Tennessee Valley Authority (TVA).

In this part, except as otherwise specified, references to the Governor shall be deemed to refer also to the TVA and references to the State Plan shall be deemed to refer also to the TVA Plan. References in this part to a State as a geographic area shall, with respect to the TVA Plan, be referenced to the service areas of the covered utilities subject to the TVA Plan. Reference in this part to a State as a governmental entity (other than references to State laws or regulations) or to any State Agency or officer shall be deemed to refer also to the TVA.

§ 456.207 Temporary Programs.

(a) *Definition of Temporary Program.* A Temporary Program is a plan or a part of a State Plan which exempts in whole or in part for a specified period, to be determined by the Assistant Secretary, one or more utilities from one or more of the following provisions—

(1) The requirements for preparing and distributing the Program Announcement described in § 456.305;

(2) The requirements for offering and performing, audits described in § 456.306;

(3) The requirements concerning accounting and payment of costs described in § 456.309;

(4) The requirements regarding billing of costs, repayment of loans, and termination of service described in § 456.310; and

(5) The prohibition against supplying and installing by covered utilities described in § 456.502(a).

(b) *Continuation.* Temporary programs approved by the Secretary prior to August 28, 1986, may be extended until such date as determined by the Secretary.

(c) *Federal Standby Authority.* The Federal Standby Authority described in Subpart F shall not be exercised with respect to a covered utility which either—

(1) Is subject to an approved Temporary Program; or

(2) Was subject to an approved Temporary Program which has terminated and such covered utility will be subject, within a reasonable time to be determined by the Assistant Secretary, to an adequately implemented approved State Plan or Nonregulated Utility Plan.

§ 456.208 Status of Plans Approved Prior to CSRA.

Any residential energy conservation plan approved by the Secretary before August 28, 1986, shall continue as approved, provided certification is made to the Secretary that—

(a) The plan will continue until June 30, 1989, and one more program announcement will be made;

(b) The definition of "residential building" will be amended to "any building used for residential occupancy which is not a new building to which final standards under section

304(a) of the Energy Conservation and Production Act apply and which has a system for heating or cooling, or both; and

(e) Program coverage will include multi-family buildings containing five or more units when the dwelling units are individually metered for heating or cooling.

Subpart C—Content of State Plans

§ 456.301 Scope.

This subpart prescribes the minimum requirements for the content of State Plans. The State may include additional information and provide additional requirements in the State Plan for the RCS Program if such information and requirements are not specifically prohibited by these rules or by any applicable law or regulation. All references in this subpart to covered utilities apply to regulated and nonregulated covered utilities subject to the State Plan.

§ 456.302 Coverage of State Plan.

(a) *Regulated utilities.* All regulated utilities providing utility service in a State which meet the definition of "covered utility" in § 456.105 shall be subject to the State Plan and shall be identified in the State Plan.

(b) *Nonregulated utilities.* The State Plan shall identify which nonregulated covered utilities, if any, are covered under the State Plan.

(c) *Home heating suppliers.* The State Plan shall state whether it includes an RCS Program for home heating suppliers.

(d) *Temporary Programs.* The State Plan shall identify any covered utilities for which a request for a Temporary Program provision has been submitted, and describe or attach such provision for each such utility.

§ 456.303 Procedures for enforcing compliance with State Plan.

(a) For the purposes of this section the term "RCS participant" means any person or entity directly governed by the State Plan, including covered utilities, and participating home heating suppliers.

(b) The State Plan shall require each RCS participant to comply with the State Plan.

(c) The State Plan shall contain adequate procedures for enforcing compliance with the State Plan by each RCS participant.

§ 456.304 State monitoring of utility supply, installation, and financing.

The State Plan shall—

(a) Contain procedures to ensure that covered utilities which supply, install or finance the sale or installation of energy conservation or renewable resource measures shall—

(1) Charge fair and reasonable prices and interest rates, which shall be determined by periodic review of comparative prices and interest rates by a State designated agency;

(2) Conduct such activities in a manner which does not have a substantial adverse effect upon competition or involve the use of unfair, deceptive, or anticompetitive acts of practices;

(3) When undertaking to finance a lending program for such measures through financial institutions, seek funds for such financing from financial institutions located throughout the area covered by the lending program (to the extent each such utility determines feasible, consistent with good business practice, and not disadvantageous to its customers); and

(4) Meet the requirements of § 456.504 if they undertake supply or installation activities under § 456.504.

(b) Require any utility undertaking a program involving the supply or installation of any energy conservation or renewable resource measure as permitted by § 456.504, or providing financing for the purchase or installation of any such measure, to notify the Assistant Secretary when such program becomes effective.

§ 456.305 Program announcement.

(a) *Distribution and content.* The State Plan shall require each covered utility and each participating home heating supplier to provide each eligible customer, no later than six months after approval of the State Plan and every two years thereafter, but not more than once during the period from August 28, 1986 to June 30, 1989, with the following:

(1) A list of the program measures for the category of residential buildings owned or occupied by such eligible customer.

(2) A reasonable estimate (or range of estimates) of the savings in energy costs for a specified period of time which are likely to result from installation of each of the program measures in a typical building or buildings in such category.

(3) A list of the energy conserving practices which shall be developed by the Governor. Such practices may include the practices defined in § 456.105.

(4) A reasonable estimate (or range of estimates) of the savings in energy costs for a specified period of time which are likely to result from the adoption of the practices, individually or as a group.

(5) An offer to perform the service required to be offered under § 456.306 (Program Audits) and a description of the service. The offer of the program audit may be conditioned upon a nondiscriminatory factor such as serving one geographic area at a time or serving a certain type of energy user first.

(b)(1) The State Plan shall specify whether a covered utility or participating home heating supplier is permitted or prohibited from including with the program information any advertising for the sale, installation or financing by any supplier, contractor, or lender (including the covered utility) of any program measure.

(2) If advertising is permitted, the State Plan shall contain procedures to ensure that such advertising does not unfairly discriminate against any person.

(c) *Calculation procedures.* The State Plan shall, with respect to estimates of the savings required under § 456.305(a)(2), describe the procedures by which such estimates shall be made.

(d) *New customers.* (1) A new customer is a person who becomes an eligible customer after a distribution of the Program Announcement but before June 30, 1989.

(2) The State Plan shall require that each covered utility and participating home heating supplier provide each new customer within 60 days of such customer becoming a new customer with the information required in § 456.305(a).

(3) The State shall require that a covered utility or participating home heating supplier retain in its files for not less than five years a copy of each report of each program audit performed pursuant to the State Plan which shall be available to any subsequent owner without charge. The State Plan shall require that a covered utility or participating home heating supplier inform each subsequent eligible customer who is an owner of a residential building, or dwelling unit therein, of the availability of this report.

(e) The State Plan shall prohibit unfair discrimination among measures, eligible customers, suppliers, contractors, and lenders in the content of, and in the providing of, information required under this section.

§ 456.306 Requirements for program audits.

(a) *Timing of program audit.* The State Plan shall require that each covered utility participating home heating supplier shall provide a program audit to each eligible customer within a reasonable time after the request for an audit.

(b) *Content of program audit.* (1) The State Plan shall describe the program audit services to be offered by utilities and participating home heating suppliers and shall require at a minimum that covered utilities and participating home heating supplier provide (either directly or through one or more auditors under contract), upon request, to each eligible customer a program audit which addresses the applicable program measures and identifies the applicable energy conserving practices which shall be developed by the Governor. Such practices may include those practices defined in § 456.105.

(2) The State Plan may allow the auditor in each program audit to determine the applicability of each pro-

gram measure in that residence based on applicability criteria set forth in the State Plan subject to DOE approval; and, in the case of residential buildings containing more than four dwelling units, based on either the above or DOE applicability criteria and usage cut-off procedures, as set forth in Appendix III. If a program measure is not applicable, then the requirements of this section to provide estimates of the cost and savings of installation of such measure in such residence do not apply.

(3) The State Plan shall contain procedures to assure the validity of the program audit with respect to all program measures.

(4) The State Plan shall require the auditor to offer at the time of the audit to provide the customer at a minimum with a written sample of the typical format of the audit results and a brief explanation of how to interpret such results.

(5) The State Plan shall allow auditors to perform a program audit only for those measures or products approved by the Governor.

(c) *Results of program audit.* (1) The State Plan shall require that the utility provide the following information in writing to each eligible customer who receives a program audit—

(i) An estimate of the total cost, expressed in dollars or a range of dollars, of installation by a contractor of each applicable program measure as designated in the Table of Program Measures (Appendix I);

(ii) An estimate of the total cost, expressed in dollars or a range of dollars, of purchase by the customer of each applicable program measure as designated in the Table of Program Measures (Appendix I);

(iii) An estimate of the energy savings, expressed in dollars or a range of dollars, of each applicable program measure addressed by the program audit.

(2) The State Plan shall require any utility which does not provide in-person results of audits to provide customers with the opportunity to discuss the results of the audit with a qualified person.

(3) The State Plan shall allow utilities to provide audit results only for those measures or products approved by the Governor.

(d) *Prohibitions.* (1) The State Plan shall prohibit covered utilities and participating home heating suppliers from discriminating unfairly among eligible customers in providing program audits.

(2) The State Plan shall prohibit any auditor from recommending any supplier, contractor, or lender who supplies, installs, or finances the sale or installation of any program measure if such recommendation would unfairly discriminate among such suppliers, contractors, or lenders.

(3) The State Plan shall prohibit any unfair discrimination among program measures.

(e) *Program audits of furnaces.* The State shall require that, in order for an auditor of a covered utility or participating home heating supplier to provide cost and savings estimates for furnace efficiency modifications with respect to a furnace which uses as its primary source of energy any fuel or source of energy other than the fuel or source of energy sold by that covered utility or participating home heating supplier, the eligible customer must request such audit in writing.

(f) *Qualifications for program auditors.* The State Plan shall require that each person who performs a program audit pursuant to the State Plan shall be qualified to perform the necessary measurements and inspections to determine the estimated cost of purchasing and installing the recommended program measures and the savings in energy costs that are likely to result from the installation of such measures.

§§ 456.307—456.308 [Reserved]

§ 456.309 Accounting and payment of costs.

(a) *Accounting.* The State Plan shall require with respect to Federally mandated measures, and may permit with respect to costs or revenues directly associated with State measures, that all amounts expended or received by a covered utility which are attributable to the RCS Program, including any penalties paid under Subpart F (Federal Standby Authority), shall be accounted for on the books and records separately from amounts attributable to all other activities of the covered utility.

(b) *Payment of costs.* The State Plan shall require that covered utilities treat costs as described below and shall describe how the costs described in paragraph (b)(2) of this section will be treated:

(1) All amounts expended by a covered utility in providing the information required under § 456.305(a) and in conducting all public education and program promotion directly related to providing information about a utility's RCS Program shall be treated as a current expense of providing utility service and be charged to all ratepayers of the covered utility in the same manner as other current operating expenses of providing such utility service;

(2) The cost of the following program elements shall be recovered in the manner specified by the State regulatory authority (in the case of a regulated utility) or the nonregulated utility (except that the amount that may be recovered directly from a residential customer for whom the activities described in § 458.309(b)(2)(ii) are performed shall not exceed a total of $15 per dwelling unit or the actual cost of such activities, whichever is less);

(i) Administrative and general expenses, including those associated with program audits and customer billing services, and

(ii) Project management requirements, including the providing of program audits; and

(3) In determining the amount to be recovered directly from customers as provided in paragraph (b)(2) of this section, the State regulatory authority (in the case of a regulated utility) or the nonregulated utility shall take into consideration, to the extent practicable, the eligible customers' ability to pay and the likely levels of participation in the utility program which will result from such recovery.

(c) *Duplication of audits.* (1) In areas where a residential customer is an eligible customer of more than one covered utility, the Governor, or the covered nonregulated utility, as appropriate, may include in a State Plan or a Nonregulated Utility Plan procedures to ensure that each eligible customer may receive an RCS audit from only one of these covered utilities.

(2) No utility should be required to make more than one audit of a residential building or dwelling unit therein unless a new owner requests a subsequent audit.

§ 456.310 Customer billing, repayment of loans, and termination of service.

The State Plan shall require that—

(a) *Customer billing.* Every charge by a covered utility or a participating home heating supplier to a customer for any portion of the costs of carrying out any activity pursuant to the State Plan that is charged to the residential customer for whom such activity is performed (including repayment of a loan) and that is included on a billing for utility service submitted by the utility or home heating supplier to such residential customer shall be stated separately on such billing from the cost of providing utility or fuel service. Nothing in this paragraph shall be construed so as to require that charges to the customer for activities performed pursuant to the State Plan must be included on the bill for periodic utility service.

(b) *Repayment of loans.* (1) In the case of any loan by a covered utility, the utility, with the approval of the customer, shall permit repayment of the loan as part of the periodic utility bill.

(2) In the case of any loan for the purchase or installation of program measures made by a participating home heating supplier under the RCS Program—

(i) The participating home heating supplier shall permit the eligible customer to include repayment of the loan in such customer's payment of his periodic fuel bill over a period of not less than three years, unless the eligible customer chooses a shorter repayment period;

(ii) A lump-sum payment of outstanding principal and interest may be required by the lender upon default in payment (as determined under appliable law) from the eligible customer; and

(iii) No penalty shall be imposed by a home heating supplier for payment of all or any portion of the outstanding loan amount prior to the date such payment would otherwise be due.

(c) *Termination of service.* No covered utility or participating home heating supplier shall terminate utility or fuel service to any customer for any default by such customer for payments due for any services under the RCS Program.

§ 456.311 [Reserved]

§ 456.312 Complaints processing and redress procedures.

The State Plan shall contain procedures—

(a) For resolving complaints against persons who sell or install energy conservation or renewable resource measures under the RCS Program; and

(b) To assure that any person who alleges any injury resulting from a violation of any State Plan provision shall be entitled to redress.

§ 456.313 Coordination.

The State Plan shall provide procedures to ensure effective coordination between the RCS Program and all local, State, and Federal energy conservation programs within and affecting the State.

§ 456.314 Home heating suppliers.

(a) *Consideration of limited resources.* If a State Plan covers home heating suppliers, it shall, within the terms of the requirements of this subpart, take into account the limited resources of small home heating suppliers.

(b) *Participation and withdrawal.* The State Plan, if it includes home heating suppliers, shall include a procedure by which the Governor shall allow a home heating supplier to participate in the RCS Program. The State Plan shall also allow a home heating supplier to withdraw voluntarily from the RCS Program.

(c) *Waiver of requirements.* The State Plan shall contain a procedure by which the Governor may waive for any participating home heating supplier any requirement of the State Plan, except those listed below, upon a demonstration to the Governor's satisfaction that the resources of such supplier do not enable it to comply with the particular requirement. The requirements which the Governor shall not waive are the following sections which prohibit anticompetitive activities or unfair discrimination by covered utilities or participating home heating suppliers—

(1) Section 456.306(c) (Prohibitions concerning program audits); and

(2) Section 456.306(d) (Furnace audits).

§ 456.315 Program measures.

(a) The State Plan shall contain a list of the program measures. This list shall contain either those energy conservation and renewable resource measures identified in Appendix I to this rule as program measures for that State, or a list of energy conservation and renewable resource measures determined to be program measures by the Governor in accordance with paragraph (b) of this section.

(b)(1) The Governor may exclude from the State RCS Program, any program measure identified in Appendix I as a program measure for that State on the following bases:

(i) When, by substituting State derived data, the program measure has a payback period (P) of more than seven years, as determined by dividing the installed first cost (F) less any Federal and State (at the discretion of the Governor) tax credits (T), by the first year energy savings in dollars (S),

$$P = \frac{F-T}{S} \quad P>7 \text{ years, and/or}$$

(ii) When, by substituting a State specific prototypical house, it is determined that the program measure has a payback period (P) of more than seven years pursuant to the formula in paragraph (b)(1)(i) of this section.

(2) The State Plan shall contain data to substantiate any exclusion pursuant to paragraphs (b)(1) (i) or (ii) of this section.

(c) The Governor may add any measure not identified in Appendix I as a program measure for that State, to the State RCS Program without DOE approval.

§ 456.316 Reporting and recordkeeping.

(a) The State Plan shall contain provisions to assure that a report is submitted to the Assistant Secretary no later than July 1, 1982, and annually thereafter through June 30, 1989, covering the twelve-month period ending the preceding April 1.

(b)(1) The report shall include—

(i) The number of energy audits requested, and/or provided;

(ii) The nature and status of any direct financing activities or exempted or waived supply or installation activities engaged in by the utilities;

(iii) Estimated State costs and utility costs of implementing the program; and

(iv) The general nature and approximate number of complaints received about the program and the operation of the complaints processing procedures of § 456.309 in the State.

(2) The report shall also contain a copy of any program announcement not already provided.

(c) The State Plan shall contain procedures to assure that a copy of the data collected during each audit and a copy of the costs and savings presented to the customer receiving the audit are retained on file for five years from the date of the audit.

(d) Any other provisions of this section notwithstanding, the Assistant Secretary may, as he deems essential to Departmental implementation of program responsibilities and subject to approval of OMB under the provisions of the Paperwork Reduction Act (Pub. L. 96-511)—

(1) Require additional information; and

(2) Waive any reporting and recordkeeping requirements, except the recordkeeping requirements in paragraph (c) of this section.

§ 456.317 Quality assurance.

The State Plan shall contain procedures to ensure that reasonable levels of effectiveness and safety are maintained in the supply and installation of measures under the RCS Program.

Subpart D—Nonregulated Utility Plans

§ 456.401 Scope.

This subpart identifies the responsibilities of covered nonregulated utilities not subject to a State Plan for the preparation and submission of Nonregulated Utility Plans, the procedures for approval of Nonregulated Utility Plans by the Assistant Secretary, and the minimum requirements for the content of Nonregulated Utility Plans.

§ 456.402 Coverage.

This subpart shall apply to all nonregulated utilities which are not covered by a State Plan.

§ 456.403 Notice, comment, and public hearing.

Prior to submission of the Nonregulated Utility Plan to the Assistant Secretary for approval, the nonregulated utility shall—

(a) *Notice and comment.* Provide meaningful public notice of the requirement for the nonregulated utility to submit a Nonregulated Utility Plan.

(b) *Hearing.* Hold at least one public hearing in the nonregulated utility's service area for the purpose of hearing testimony and receiving comments on the content of the proposed Nonregulated Utility Plan.

§ 456.404 Procedures for submission and approval of Nonregulated Utility Plans.

(a) *Submission.* Each utility subject to this subpart shall submit to the Assistant Secretary a proposed Nonregulated Utility Plan by June 4, 1980, unless the time for submission has been extended by the Assistant Secretary for good cause shown upon request, of the nonregulated utility.

(b) *Approval.* If a proposed Nonregulated Utility Plan meets the criteria of this subpart, the Assistant Secretary shall approve it within 90 days of the date the proposed Nonregulated Utility Plan was submitted.

(c) *Disapproval.* (1) If a Nonregulated Utility Plan does not meet the criteria of this subpart, the Assistant

Secretary shall, within 90 days of the date the proposed Nonregulated Utility Plan is submitted, disapprove the proposed Nonregulated Utility Plan and specify in writing grounds for disapproval.

(2) Within 60 days of the date of disapproval of a proposed Nonregulated Utility Plan, or such longer period as the Assistant Secretary may determine pursuant to the criteria of paragraph (a) of this section, the nonregulated utility shall submit another proposed Nonregulated Utility Plan.

(d) *Amendments.* The nonregulated utility may submit proposed amendments to an approved Nonregulated Utility Plan at any time. The Assistant Secretary shall approve or disapprove a proposed amendment within 90 days of receipt of the proposed amendment.

§ 456.405 Temporary Programs.

A nonregulated utility may operate a Temporary Program as defined in § 456.207(a) in accordance with the provisions of § 456.207.

§ 456.406 Content of plans.

(a) *General requirements.* (1) Except as provided in this section, each Nonregulated Utility Plan shall meet all the requirements for State Plans in Subpart C.

(2) Except as otherwise provided in this section, all references in Subpart C to—

(i) Covered utilities shall be deemed to refer to utilities subject to this subpart;

(ii) A State Plan shall be deemed to refer to a Non-Regulated Utility Plan;

(iii) Participating home heating suppliers shall not apply;

(iv) A State (as a governmental entity, other than references to State laws or regulations) or any State Agency or officer shall be deemed to refer to the nonregulated utility submitting the Plan; and

(v) A State (as a geographic area) shall be deemed to refer to the nonregulated utility's service area.

(b) *Utilizing State services.* (1) In a State submitting a State Plan, a nonregulated utility may, by written understanding with the appropriate State agency, utilize services which have been provided for in the State Plan.

(2) If a Nonregulated Utility Plan utilizes services as permitted by this paragraph, all references in the State Plan to those services with regard to utilities subject to the State Plan shall be deemed to refer to the nonregulated utility.

(3) If a Nonregulated Utility Plan proposes to utilize any of the services pursuant to this paragraph, the Plan shall so state and copies of the written agreements with the appropriate State agencies shall be included with the Nonregulated Utility Plan in the submission to the Assistant Secretary.

Subpart E—Supply, Installation, and Financing by Utilities

§ 456.501 Scope and definitions.

(a) This subpart contains the prohibition against a utility's supply and installation of energy conservation and renewable resource measures. It specifies the exemptions to this prohibition and the procedures, where applicable, for obtaining these exemptions. It also sets forth certain requirements concerning utility financing programs.

(b) For purposes of this subpart—(1) A "covered utility" means a covered utility, any company which is owned or controlled by such a utility, or any company which owns or controls such a utility;

(2) A covered utility "installs" a measure whenever the contract for installation obligates the covered utility to install the measure;

(3) A covered utility "supplies" a measure when it sells a measure at retail or leases a measure to an eligible customer; and

(4) A covered utility "finances" the supply or installation of a measure when the loan contract names the utility as the lender.

§ 456.502 Prohibition.

(a) Except as provided in this subpart, no covered utility may supply or install any energy conservation or renewable resource measure.

(b) Notwithstanding §§ 456.503-456.507, no covered utility may supply, install, or finance the supply or installation of any energy conservation or renewable resource measure if the Federal Trade Commission, pursuant to Section 216(h) of NECPA, or a State regulatory authority, pursuant to State law, has determined that such activity involves—

(1) Charging unfair or unreasonable prices or rates of interest with respect to the supply and installation of residential energy conservation measures; or

(2) Engaging in unfair methods of competition or unfair or deceptive acts or practices with respect to such supply and installation.

(c) Violations of this section are subject to a civil penalty of not more than $25,000 for each day of violation assessed by order of the Assistant Secretary pursuant to Section 216(h) and 219 of NECPA and § 456.606 of these rules.

§ 456.503 Exemption for certain measures.

The prohibition in § 456.502(a) shall not apply to the supply or installation of (a) furnace efficiency modifications, (b) clock thermostats, and (c) devices associated with load management techniques for the type of energy sold by the utility.

§ 456.504 Exemption for utility subcontractor supply and installation.

(a) The prohibition contained in § 456.502(a) shall not apply to any energy conservation measure or renewable resource measure supplied or installed by a public utility through contracts between such utility and independent suppliers or contractors where the customer requests such supply and installation and each supplier or contractor—

(1) Is not subject to the control of the public utility, except as to the performance of such contract, and is not an affiliate or a subsidiary of such utility; and

(2) If selected by the utility, is selected in a manner consistent with § 456.504(b).

(b) Activities of a public utility conducted pursuant to paragraph (a)(2) of this section—

(1) May not involve unfair methods of competition;

(2) May not have a substantial adverse effect on competition in the area in which such activities are undertaken nor result in providing to any supplier or contractor an unreasonably large share of contracts for the supply or installation of energy conservation or renewable resource measures;

(3) Shall be undertaken in a manner that provides, subject to reasonable conditions the utility may establish to ensure the quality of supply and installation of energy conservation or renewable resource measures, that any financing by the utility of such measures shall be available to finance the supply or installation by any contractor or to finance the purchase of such measures to be installed by the customer;

(4) Shall be undertaken, to the extent practicable and consistent with paragraphs (b)(1)-(3) of this section, in a manner that minimizes the cost of energy conservation and renewable resource measures to such customers; and

(5) Shall include making available upon request a current estimate of the average price of supply and installation of energy conservation and renewable resource measures subject to the contracts entered into by the public utility under paragraph (a) of this section.

(c) Before a utility can undertake a supply or installation program permitted by this section, the State Plan must contain procedures to ensure that such a program will be undertaken in full compliance with requirements described in paragraphs (a) and (b) of this section.

§ 456.505 Exemption for existing supply and installation.

(a) The prohibition in § 456.502(a) shall not apply to any supply or installation of any energy conservation or renewable resource measure in which the covered utility was engaged on November 9, 1978—

(1) During such time as applications for determinations with respect to such activities, filed in accordance with § 456.509, are pending; and

(2) Upon a final determination that, on or by November 9, 1978, such

energy conservation or renewable resource measure was being supplied or installed by the utility seeking such determination.

(b) The prohibition in § 456.502(a) shall not apply to any supply or installation of any energy conservation or renewable resource measure which the covered utility had by November 9, 1978, broadly advertised that it would supply or install, or with respect to which the utility had by November 9, 1978, completed substantial preparations for supplying or installing—

(1) During such time as applications for determinations with respect to such activity filed in accordance with § 456.509 are pending; and

(2) Upon a final determination that, on or by November 9, 1978, such energy conservation or renewable resource measure had been broadly advertised or for which substantial preparations had been completed by the utility seeking such determination.

(c) Effective July 1, 1987, paragraphs (a) and (b) shall not apply to the supply or installation of residential energy conservation measures other than measures which the Secretary determines, pursuant to a request by a covered utility with supporting documentation, were being installed or supplied during the 12 month period ending June 1, 1985.

§ 456.506 Exemption for supply and installation authorized by State or local law.

(a) The prohibition in § 456.502(a) shall not apply to any supply or installation of any energy conservation or renewable resource measure—

(1) In which a State or local law or regulation in effect on November 9, 1978, required or explicitly permitted a covered utility to engage; or

(2) Which the Attorney General of the appropriate State certifies to the Assistant Secretary was intended by a State law or regulation in effect on November 9, 1978, to be required or permitted.

(b) A covered utility is exempt from any Federal requirement to include in its RCS Program any supply or installation of any energy conservation or renewable resources measure in which it is engaged by reason of a State law or regulation in effect prior to November 9, 1978, permitting or requiring such activities. However, a covered utility that includes supply and installation in its RCS Program pursuant to the exemption in paragraph (a) of this section shall be subject to all the requirements of the State Plan with respect to those activities in the same manner as any contractor, supplier, or lender, except that it shall be exempt from the requirements of § 456.309 (Accounting and Payment of Costs) and § 456.310 (Customer Billing, Repayment of Loans, and Termination of Service) with respect to such activities.

§ 456.507 Waivers.

(a) The Assistant Secretary may waive any prohibition of § 456.502(a) upon petition by a covered utility pursuant to § 456.509 and a finding that—

(1) The petition, in the case of a covered utility subject to a State Plan, is supported by the Governor; and

(2) If such waiver were granted—

(i) Fair and reasonable prices and rates of interest would be charged; and

(ii) The otherwise prohibited activities would not involve or result in unfair or deceptive acts or practices.

(b) Before the Assistant Secretary makes the finding described in paragraph (a)(2)(i) of this section, he or she shall consult with the Federal Trade Commission.

§ 456.508 Notification.

Each utility undertaking a program involving the supply or installation of any energy conservation or renewable resource measure as permitted under § 456.504, or providing financing for the purchase or installation of any such measure, must notify the Assistant Secretary when such program becomes effective.

§ 456.509 Procedure for obtaining determinations and waivers.

(a) A utility making an application for a determination under § 456.505 or a petition for a waiver under § 456.507 shall file such application or petition clearly labeled as such with the Assistant Secretary for Conservation and Renewable Energy, Department of Energy, 1000 Independence Avenue, SW., Washington, DC 20585. All such

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petitions shall contain all information necessary for the determination under § 456.505 or the findings required by § 456.507.

(b) In addition to any other requirement that may be applicable, any utility making an application or petition under this section shall give direct notice to the Governor, State Energy Office, and State Regulatory Authority of any State in which such exemption or waiver would be applicable, informing them that they may within ten days submit comments on the application or petition to the Assistant Secretary. The application or petition filed with the Assistant Secretary shall include a certification that the applicant or petitioner has complied with the requirements of this paragraph. In the discretion of the Assistant Secretary, opportunity to comment may be provided to other interested persons.

§ 456.510 Appeals.

Any person adversely affected by any decision made pursuant to this subpart by the Assistant Secretary may appeal that decision in accordance with Subpart H of 10 CFR Part 205. All such appeals shall be filed with the Office of Hearings and Appeals, Department of Energy, Washington, DC 20585.

§ 456.511 Certain exempt activities and compliance with accounting, costing, billing, and repayment provisions.

Any covered utility conducting activities pursuant to the exemptions provided for in § 456.503, § 456.504 or § 456.505(b) or the waiver provisions of § 456.507 shall comply with the requirements of §§ 456.309 (a), (b)(2), and (b)(3), and § 456.310 with respect to those activities. Any covered utility carrying out activities pursuant to the exemptions provided for in § 456.505(a) shall, within such reasonable time as the Secretary prescribes, comply with the requirements of §§ 456.309 (a), (b)(2), and (b)(3), and § 456.310 with respect to such activities.

Subpart F—Federal Standby Authority and Enforcement Provisions

§ 456.601 Scope.

This subpart specifies the procedures to be followed to ensure that eligible customers receive the services of the Residential Conservation Service Program when a State or nonregulated utility does not submit an acceptable Residential Conservation Service Plan within the necessary time or fails to implement adequately an approved RCS or Alternative plan. These procedures are required to be implemented by the Secretary pursuant to the provisions of section 219 of NECPA. All of the Secretary's responsibilities under this subpart, except for the authority to bring actions in any court of the United States, have been delegated to the Assistant Secretary. Section 456.602 specifies the conditions under which the Assistant Secretary shall invoke standby authority for covered regulated utilities and covered nonregulated utilities. Sections 456.603 and 456.604 specify the content of the Federal plans for States and nonregulated utilities, respectively. Section 456.605 specifies the procedures to be followed by the Secretary if a public utility fails to comply with a Federal standby order issued pursuant to §§ 456.603 or 456.604. Section 456.606 specifies the civil penalties which the Assistant Secretary may assess and the enforcement provisions.

§ 456.602 Conditions under which standby authority shall be invoked.

The Assistant Secretary shall invoke standby authority if he concludes:

(a) That a State fails to submit a Residential Conservation Service Plan meeting the requirements of Subparts B and C by September 2, 1980, or within such additional period as the Assistant Secretary allows pursuant to § 456.204 (b) or (d);

(b) That a nonregulated utility fails to submit a Residential Conservation Service Plan meeting the requirements of Subpart D by September 2, 1980, or within such additional period as the Assistant Secretary allows pursuant to § 456.404 (a) or (c);

(c) That 30 days have elapsed after a determination that an approved State RCS or alternative plan is not being adequately implemented in a State is final and may not be appealed under section 226(f)(2) of NECPA: or

(d) After notice and opportunity for a public hearing, that an approved plan is not being adequately implemented by a covered nonregulated utility.

§ 456.603 Standby authority in lieu of State plans.

When the Assistant Secretary determines that one of the conditions specified in §§ 456.602 (a) or (c) exists;

(a) The Assistant Secretary shall promulgate a Residential Conservation Service Plan which meets the appropriate requirements of Subpart B and C of this part and which is applicable to each covered regulated utility in the State;

(b) The Assistant Secretary shall, by order, require each covered regulated utility in the State to carry out a Residential Conservation Service Program, which meets the requirements of the plan promulgated pursuant to paragraph (a) of this section, within 90 days of the issuance of the order; and

(c) If the State had an approved plan which included nonregulated utilities, the Assistant Secretary shall take the actions described in §§ 456.604 (a) and (b) with respect to such nonregulated utilities.

§ 456.604 Standby authority for nonregulated utilities.

When the Assistant Secretary determines that one of the conditions specified in §§ 456.602 (b) or (d) exists;

(a) The Assistant Secretary shall, by order, require the covered nonregulated utility to promulgate a plan which meets the requirements of Subpart D of this part; and

(b) The Assistant Secretary shall, by order, require such nonregulated utility to carry out a Residential Conservation Service Program, which meets the requirements of the plan promulgated pursuant to paragraph (a) of this section, within 90 days of the issuance of the order.

§ 456.605 Failure to comply with orders.

If the Secretary determines that any covered utility to which an order has been issued pursuant to §§ 456.603(b), 456.604(a), or 456.604(b) has failed to comply with such order, the Secretary may file a petition in the appropriate United States district court to enjoin such utility from violating the order.

§ 456.606 Enforcement provisions; Penalties; Election of review procedures.

(a) Any covered utility which violates any requirement of a plan promulgated under §§ 456.603(a) or 456.604(a), or which fails to comply with an order under §§ 456.603(b), 456.604(a), or 456.604(b) within 90 days from the issuance of such order, or which violates the prohibition in § 456.502 concerning supply, installation, or financing by covered utilities, shall be subject to a civil penalty of not more than $25,000 for each violation.

(b) Each day that such violation continues shall be considered a separate violation.

(c) A civil penalty under this section shall be assessed by an order of the Assistant Secretary.

(d) Before issuing an order assessing a civil penalty against any person under this section, the Assistant Secretary shall provide to such person notice of the proposed penalty. The notice of proposed penalty shall inform the person of the opportunity to make an election, in writing, within 30 days after receipt of the notice. The election involves deciding whether to have the procedures of paragraph (f) of this section apply, in lieu of the procedures in paragraph (e) of this section, with respect to the assesment of a civil penalty.

(e)(1) Unless the election described in paragraph (d) of this section is made within 30 calendar days after receipt of the notice given under paragraph (d) of this section, the Assistant Secretary shall assess the penalty, by order, after a determination of violation has been made on the record. Such determination of violation shall be made after an opportunity has been afforded for an agency hearing pursuant to section 554 of Title 5, United

States Code, before an administrative law judge appointed under section 3105 of Title 5. The assessment order shall include the administrative law judge's findings and the basis for such assessment.

(2) Any person against whom a civil penalty is assessed under this paragraph (e) may, within 60 calendar days after the date of the order of the Assistant Secretary assessing the penalty, institute an action in the United States court of appeals for the appropriate judicial circuit for judicial review of such order in accordance with Chapter 7 of Title 5, United States Code. The court shall have jurisdiction to enter a judgment affirming, modifying, or setting aside, in whole or in part, the order of the Assistant Secretary, or the court may remand the proceedings to the Assistant Secretary for such further action as the court may direct.

(f)(1) In any case where the procedures of this paragraph (f) have been elected, as described in paragraph (d) of this section, the Assistant Secretary shall assess such penalty by order. The order shall be made not later than 60 calendar days after the alleged violator's date of receipt of notice of the proposed penalty under paragraph (d) of this section.

(2) If the civil penalty assessed by order under paragraph (f)(1) of this section has not been paid within 60 calendar days after the assessment order was made, the Secretary shall institute an action in the appropriate district court of the United States for an order affirming the assessment of the civil penalty. The court shall have authority to review de novo the law and the facts involved, and shall have jurisdiction to enter a judgment enforcing, modifying, and enforcing as so modified, or setting aside in whole or in part, such assessment.

(3) Any election to have this paragraph (f) apply may not be revoked except with the consent of the Assistant Secretary.

(g) If any person, fails to pay an assessment of a civil penalty after it has become a final and unappealable order under paragraph (e) of this section, or after the appropriate district court has entered final judgment in favor of the Secretary under paragraph (f) of this section, the Secretary shall recover the amount of such penalty in any appropriate district court of the United States. In such action, the validity and appropriateness of the respective final order or judgment imposing the civil penalty shall not be subject to review.

(h) Notwithstanding the provisions of Title 28, United States Code, or of section 502 of the Department of Energy Organization Act, the Secretary shall be represented by the General Counsel of the Department of Energy (or any attorney or attorneys with the Department of Energy designated by the Secretary) who shall supervise, conduct, and argue any civil litigation to which this section applies (including any related collection action) in a court of the United States or in any other court,except the Supreme Court. However, the Secretary or the General Counsel shall consult with the Attorney General concerning such litigation and the Attorney General shall provide, on request, such assistance in the conduct of such litigation as may be appropriate.

Subparts G–I—[Reserved]

Subpart J—Residential Conservation Service Federal Standby Plan

§ 456.1000 Introduction.

(a) The RCS Federal Standby Plan (FSP or Plan) specifies the procedures to be followed to ensure that eligible customers receive the services of the RCS Program when a State does not submit an acceptable RCS Plan within the necessary time or fails to implement adequately an approved plan.

(b) This Plan sets forth the functions which utilities subject to the Plan will be ordered to perform. The core of the Plan is the offer of an onsite energy audit of an eligible customer's residence.

(c) In implementing the Federal Standby Plan, the Assistant Secretary shall have the discretion to allow a utility which is currently complying in good faith with an approved RCS State plan to continue to operate under that plan even though the State lead agency has relinquished or been relieved of its responsibilities. Furthermore, the Assistant Secretary shall have the discretion to allow any utility in a Federal Standby State which is currently operating under an approved RCS Program in a separate State to operate a similar program in the Standby State. In accordance with § 456.1022, the utility shall submit to DOE for approval a copy of the RCS Plan under which it is currently operating.

§ 456.1001 Definitions.

All definitions set forth in § 456.105 are applicable where relevant to this subpart, except as set forth below.

(a) *Energy Conserving Practices.* The term "energy conserving practices" means low or no cost practices designated by the Assistant Secretary which save energy, do not require the installation of energy conservation or renewable resource measures, and do not adversely impact the RCS Federal Standby Plan. Utilities may add to or delete from the practices set forth in § 456.105, as specified in § 456.1022.

(b) *Participating Home Heating Supplier.* The term "participating home heating supplier" means a home heating supplier that has elected to participate in the RCS Federal Standby Plan.

(c) *Program Announcement.* The term "program announcement" means the RCS Program information and offer of services required to be provided by a covered utility or participating home heating supplier to each eligible customer by § 456.1006.

(d) *Program Measures.* The term "program measures" means those energy conservation or renewable resource measures which the Assistant Secretary has by rule determined to be appropriate by climatic region and fuel use category and which are found in Appendix I of this part, or which are determined to be program measures by a utility or participating home heating supplier in accordance with § 456.1016.

(e) *RCS Federal Standby Plan.* The term "RCS Federal Standby Plan" (FSP or Plan) means a plan developed pursuant to Subpart F of this part and section 219 of the National Energy Conservation Policy Act (NECPA).

§ 456.1002 Coverage of RCS Federal Standby Plan.

(a) *Regulated utilities.* All regulated utilities providing utility service in a State where the FSP is ordered to be enforced and which meet the definition of "covered utility" shall be subject to the FSP.

(b) *Home heating suppliers.* Any home heating supplier in a State where the FSP is ordered to be enforced and which wishes to participate in the FSP may so notify the Assistant Secretary.

§ 456.1003 Procedures for investigating and enforcing compliance with the RCS Federal Standby Plan.

(a) *Investigation and enforcement.* (1) The Assistant Secretary requires each utility and each participating home heating supplier subject to the FSP to comply with the Plan pursuant to the authority given the Assistant Secretary in section 219 of NECPA (42 U.S.C. 8220).

(2) Individuals or groups wishing to report possible noncompliance with this Plan shall inform the Assistant Secretary. Each utility and participating home heating supplier shall inform their customers on how to notify the Assistant Secretary with respect to such reports. This information shall be contained in the program announcement distributed pursuant to § 456.1008. The Assistant Secretary may investigate any allegation of noncompliance or any complaint concerning the RCS Program or this Plan submitted to DOE, or on his own initiative may review the activities of utilities or participating home heating suppliers subject to the FSP to determine compliance with the Plan.

(b) *Conflicts of laws.* Each utility subject to the FSP shall petition the Assistant Secretary in accordance with § 456.102 whenever the utility believes it is prohibited by a State or local law or regulation from taking any action required to be taken under NECPA or any rule or FSP promulgated pursuant to NECPA, or whenever the utility believes it is required or permitted by a

State or local law or regulation to take any action prohibited by NECPA or any rule or FSP promulgated pursuant to NECPA.

(1) The petition shall contain a copy of the applicable State or local laws or regulations and a description of the action the utility believes it is prohibited from taking or is permitted or required to take under such laws or regulations.

(2) The Assistant Secretary shall give notice of the petition to the Governor, State Energy Office, and State Regulatory Authority of the applicable State and such other persons as the Assistant Secretary deems appropriate. Any such person or entity may file comments with the Assistant Secretary with respect to such petition within 30 days of receipt of the notice.

(3) If the Assistant Secretary determines pursuant to such petition that a State or local law or regulation prohibits a utility from taking any action required to be taken under NECPA or any rule or FSP promulgated pursuant to NECPA or permits or requires a utility to take any action prohibited by NECPA or any rule or FSP promulgated pursuant to NECPA, the Assistant Secretary shall issue an order superseding such State or local laws or regulations to the extent inconsistent with NECPA or any rule or FSP promulgated pursuant to NECPA. Such an order shall be effective with respect to all utilities subject to such State or local laws or regulations and shall moot any outstanding petitions under this section by such utilities.

(c) *Appeals.* (1) Any person aggrieved by any order, finding, or determination made under paragraph (b) of this section or § 456.1017 may appeal that order, finding, or determination within 30 days in accordance with 10 CFR, Subpart H of Part 205. All such appeals shall be filed with the Office of Hearings and Appeals, Department of Energy, Washington, DC 20585.

(2) Any person so aggrieved has not exhausted his administrative remedies until an appeal has been filed under that subpart and an order granting or denying the appeal has been issued.

§§ 456.1004—456.1005 [Reserved]

§ 456.1006 Program announcement.

(a) *Distribution and content.* Each utility subject to the FSP shall send to each eligible customer a copy of the program announcement no later than 90 days after the issuance of an order from the Assistant Secretary to comply with the FSP. Each participating home heating supplier shall send to each eligible customer a copy of the program announcement no later than the date set forth in the notice from the Assistant Secretary approving participation by the home heating supplier in the FSP. A program announcement must, at a minimum—

(1) List the program measures identified in Appendix I or the program measures developed by the utility pursuant to § 456.1016, for the category of residential building owned or occupied by such eligible customer;

(2) List the energy conserving practices defined in § 456.105 and § 456.1001 or the practices developed by the utility and approved by the Assistant Secretary pursuant to § 456.1022 and state that they are of low or no cost;

(3) Include a reasonable estimate (or a range of estimates) of the savings in energy costs for a period of one year, which are likely to result from installation of each of the applicable program measures and adoption of the energy conserving practices in a typical building or buildings in such category;

(4) Include an offer to perform the service required to be offered under § 456.1007 (Program Audits);

(i) The offer of the program audit may be conditioned upon a nondiscriminatory factor such as serving one geographic area at a time or serving a certain type of energy user first. An unconditional offer, however, shall be offered to eligible customers within one year of a conditional offer.

(ii) The offer must explain that an eligible customer may request the service offered in the program announcement by a request card included in the program announcement, or by any other appropriate method which is the most convenient for the utility.

(iii) The offer must list the direct costs, if any, of receiving the service, which are to be charged to the eligible customer.

(5) Include the following disclosure or a similar statement: "The estimates contained in this program announcement are based on estimates for typical houses and local fuel prices which were in effect at the time this program announcement was published. The energy audit which we offer will provide more specific estimates for your home".

(b) *Calculation procedures.* Each utility or participating home heating supplier shall provide the Assistant Secretary, pursuant to § 456.1021, with a copy of the procedures used for determining the estimates of the savings in energy costs referred to in paragraph (a)(3) of this section.

(c) *New customers.* (1) A new customer is a person who becomes an eligible customer after a distribution of the program announcement but before June 30, 1989.

(2) Each utility and participating home heating supplier subject to the FSP shall send a program announcement which meets the requirements of this section to each new customer within 60 days of such customer becoming a new customer.

(3) Each covered utility or participating home heating supplier shall retain in its files for not less than five years a copy of each report of each program audit performed pursuant to an RCS Program. Within 60 days of becoming a new customer, each new eligible customer, who is an owner of a residential building or dwelling unit therein, shall be informed by the utility or participating home heating supplier subject to the FSP that, upon request and without charge, the customer may receive a copy of the results of any program audit of the customer's residence which the utility or participating home heating supplier may have performed pursuant to the RCS Program.

(d) *Prohibitions.* (1) The program announcement shall not include any advertising, unless approved by the Assistant Secretary pursuant to § 456.1022, for the sale, installation, or financing by any supplier, contractor, or lender (including the utility and participating homeheating supplier) of any energy conservation measure, renewable resource measure, energy conserving practice, or product. The utility or home heating supplier shall submit to DOE evidence which reasonably assures that such advertising shall not be anticompetitive or unfairly discriminate against any person.

(2) The utility or participating home heating supplier is prohibited from unfairly discriminating among measures, eligible customers, suppliers, contractors, and lenders in the content of, and in the providing of, information required under this section.

§ 456.1007 Requirements for program audits.

(a) *Timing and preconditions.* (1) Each utility or participating home heating supplier subject to the FSP that unconditionally offers an audit to an eligible customer shall provide such audit within 90 days after the customer's request for the audit.

(2) Each utility or participating home heating supplier subject to the FSP that conditionally offers an audit to an eligible customer shall provide an audit within 45 days after the customer's request.

(3) Each utility or participating home heating supplier subject to the FSP is prohibited from requiring any precondition for providing a program audit to an eligible customer and is prohibited from discriminating unfairly among eligible customers in providing program audits.

(b) *Contents of program audit.* (1) Each utility and participating home heating supplier subject to the FSP shall provide (either directly or through one or more auditors under contract) to each eligible customer, upon request, a comprehensive program audit which addresses the applicable program measures and identifies the appropriate energy conserving practices referred to in § 456.105 and § 456.1001 or those practices approved by the Assistant Secretary pursuant to § 456.1022.

(2) The auditor shall determine in each program audit the applicability of each program measure in that residence based on applicability criteria set forth below or in the case of residential buildings containing more than four dwelling units, based on the DOE applicability criteria set forth in Appendix III of this part. Additionally, any utility or participating home heating supplier may establish its own applicability criteria, subject to the approval of the Assistant Secretary pursuant to § 456.1022. If a program measure is not applicable then the requirement of this section to provide estimates of the cost and savings of installation of the measure in such residence does not apply. A program measure is applicable in a residence if:

(i) The measure is not already present in the residence and the measure can be installed practically;

(ii) Installation of the measure is not a violation of Federal, State, or local law or regulations;

(iii) With respect to ceiling insulation, the difference between the existing level of insulation in the residence and the appropriate insulation level, as determined by the Assistant Secretary, is R-11 or more;

(iv) With respect to pipe and duct insulation, there are hot water pipes and heating and cooling ducts which extend through unconditioned spaces;

(v) With respect to wall insulation, there is no insulation in a substantial portion of the exterior walls;

(vi) With respect to floor insulation, no floor insulation is present;

(vii) With respect to flue-opening modifications, the furnace combustion air is taken from a conditioned area;

(viii) With respect to clock thermostats, the residence currently has a thermostat and the existing furnace or central air conditioner is compatible with a clock thermostat;

(ix) With respect to heat-absorbing or heat-reflective window and door material, the residence has an existing central or room air conditioner;

(x) With respect to direct gain glazing systems and indirect gain systems, the living space of the residence has either a south-facing (+ or −45° of True South) wall or an integral south-facing (+ or −45° of True South) roof, which is free of major obstruction to solar radiation;

(xi) With respect to active solar domestic hot water systems, a site exists on or near the residence which is free of major obstruction to solar radiation;

(xii) With respect to active solar heating systems, or combined active solar systems, a site exists on or near the residence which is free of major obstruction to solar radiation;

(xiii) With respect to replacement solar swimming pool heaters, there is an existing heated swimming pool and a location exists on the premises which is free of major obstruction to solar radiation;

(xiv) With respect to solaria/sunspace systems, the living space of the residence has a south-facing ground-level wall, which is free of major obstructions to solar radiation;

(xv) With respect to window heat gain retardants, the living area has a window that is not shaded from summer sunshine and the residence has substantial use of energy for air conditioning;

(xvi) With respect to window heat loss retardants, the living area has a window with fewer than three panes; and

(xvii) With respect to wind energy devices:

(A) The estimated average annual wind resource in the vicinity of the site is 10 miles per hour, or greater, at 10 meters (32 feet) above ground level; and

(B) There are no major wind obstructions over 55 feet high, greater than 30 feet wide, within 100 feet of a potential location for the wind energy device.

(3) Each utility and participating home heating supplier subject to the FSP shall use as program audit procedures those obtained in the DOE Model Audit or any other audit procedures approved by DOE, pursuant to § 456.1022. For the purposes of this paragraph, the term "program audit procedures" means the measurements or inspections which the auditor must make in a customer's residence and the calculations which must be performed in making energy cost savings estimates.

(4) The auditor is required to base any cost and savings estimates for any applicable furnace efficiency modification of a gas or oil furnace or boiler on an evaluation of the seasonal efficiency of such furnace or boiler. This season efficiency shall be based on estimated peak (tuned-up) steady state efficiency corrected for cycling losses. Steady state efficiency shall be derived from the manufacturer's design data and observation of the furnace components, or by a flue gas analysis of measured flue gas temperature and carbon dioxide content.

(5) The auditor shall offer, at the time of the audit, to provide the eligible customer, at a minimum, with a written sample of the typical format of the audit results and a brief explanation of how to interpret such results.

(c) *Results of program audit.* Each utility or participating home heating supplier subject to the FSP is required to provide the following information in writing to each eligible customer who receives a program audit:

(1) An estimate of the total cost, expressed in dollars or a range of dollars, of installation by a contractor of each applicable program measure.

(2) An estimate of the total cost, expressed in dollars or a range of dollars, of purchase by the customer of each applicable program measure.

(3) An estimate of energy savings, expressed in dollars or a range of dollars, of each applicable program measure addressed by the program audit.

(4) In the case of a utility or participating home heating supplier which does not provide in-person results of audits, the customer must be given the opportunity to discuss the results of the audit with a qualified person.

(d) *Prohibitions and disclosure required for program audits.* (1) Unless otherwise approved by the Assistant Secretary pursuant to § 456.1022, the auditor is prohibited from estimating, as part of any program audit provided pursuant to the FSP, the costs or energy cost savings of installing any measure or product which is not a program measure.

(2) Auditors are prohibited from recommending any supplier, contractor, or lender who supplies, installs, or finances the sale or installation of any program measure if such recommendation would unfairly discriminate among such suppliers, contractors, or lenders.

(3) No utility, participating home heating supplier, or auditor may unfairly discriminate among program measures.

(4) Each auditor must provide the eligible customer with a written statement of any substantial interest which the person or the person's employer has, directly or indirectly, in the sale or installation of any program measures.

(e) *Program audits of furnaces.* In order for an auditor of a utility or participating home heating supplier subject to the FSP to provide cost and savings estimates for furnace efficiency modifications with respect to a furnace which uses as its primary source of energy any fuel or source of energy other than the fuel or source of energy sold by that utility or participating home heating supplier, the eligible customer must request such audit by signing a form which includes the following statement:

> If your home is heated by a source of fuel other than (state the type of fuel supplied by the utility or participating home heating supplier), only the supplier of the other fuel may audit your furnace unless you specifically request us to audit your furnace. Federal law requires that the request be in writing. If you want us to audit your furnace, although we do not supply the fuel for it please sign below.

(f) *Qualifications for program auditors.* Each auditor who performs a program audit pursuant to FSP shall:

(1) Be qualified according to the applicable procedures in § 456.1014 of this subpart; and

(2) Be under contract or subcontract to, be a employee of, or be an employee of a contractor or subcontractor to, a utility or participating home heating supplier subject to the FSP.

§§ 456.1008—456.1009 [Reserved]

§ 456.1010 Accounting and payment of costs.

(a) *Accounting.* All amounts expended or received by a utility subject to the FSP which are attributable to the

RCS Program, including any penalties paid under 10 CFR Part 456 Subpart F (Federal Standby Authority), shall be separately accounted for on the books and records from amounts attributable to all other activities of the utility.

(b) *Payments of costs.* Utilities subject to the FSP shall treat costs as described below and shall notify the Assistant Secretary, pursuant to § 456.1020, how the costs described in paragraph (b)(2) of this section will be treated.

(1) All amounts expended by a utility subject to the FSP for the program announcement and all public education and program promotion directly related to providing information about a utility's RCS Program shall be treated as a current expense of providing utility service and be charged to all ratepayers of the utility subject to the FSP in the same manner as other current operating expenses of providing such utility service.

(2) The cost of the following program elements shall be recovered in the manner specified by the State regulatory authority for all regulated utilities subject to the FSP (except that the amount that may be recovered directly from a residential customer for whom the activity described in paragraph (b)(2)(ii) of this section is performed shall not exceed $15 per dwelling unit, or the actual cost of such activities, whichever is less):

(i) Administrative and general expenses, including those associated with program audits and customer billing services.

(ii) Project manager requirements, including the providing of program audits.

(3) In determining the amount to be recovered directly from customers as provided under paragraph (b)(2) of this section, the State regulatory authority shall take into consideration, to the extent practicable, the customers' ability to pay and the likely levels of participation in the utility program which will result from such recovery.

(c) *Duplication of audits.* (1) In areas where a residential customer is an eligible customer of more than one utility or participating home heating supplier, such customer is entitled to an RCS audit from only one of these utilities or home heating suppliers.

(2) No utility or participating home heating supplier subject to the FSP shall be required to make more than one audit of a residential building or dwelling unit therein, unless a new owner, who is an eligible customer, requests a subsequent audit.

§ 456.1011 Customer billing, repayment of loans, and termination of service.

(a) *Customer billing.* Every charge to a customer by a utility or a participating home heating supplier, subject to the FSP, for any portion of the costs of carrying out any activity pursuant to the FSP that is charged to the residential customer for whom such activity is performed (including repayment of a loan) and that is included on a billing for utility service submitted by the utility or home heating supplier to such residential customer, shall be stated separately on such billing from the cost of providing utility or fuel service. Nothing in this paragraph shall be construed so as to require that charges to the customer for activities performed pursuant to the FSP must be included on the periodic utility or fuel bill.

(b) *Repayment of loans.* (1) In the case of any loan by a utility, the utility, with the approval of the customer, shall permit repayment of the loan as part of the periodic utility bill.

(2) In the case of any loan for the purchase or installation of program measures made by a participating home heating supplier under the FSP—

(i) The participating home heating supplier shall permit the eligible customer to include repayment of the loan in the customer's payment of his periodic fuel bill over a period of not less than three years, unless the eligible customer chooses a shorter repayment period;

(ii) A lump-sum payment of outstanding principal and interest may be required by the lender upon default (as determined under applicable law) in payment by the eligible customer, and

(iii) No penalty shall be imposed by a participating heating supplier for payment of all or any portion of the outstanding loan amount prior to the date such payment would otherwise be due.

(c) *Termination of service.* No utility or participating home heating supplier subject to the FSP shall terminate or otherwise restrict utility or fuel service to any customer for payments due for any services under the FSP.

§ 456.1012 [Reserved]

§ 456.1013 Quality assurance.

(a) To ensure that reasonable levels of effectiveness and safety are maintained in the supply and installation of measures under the FSP, each utility or participating home heating supplier shall develop and offer to each customer at the time of the audit or with the audit results the following:

(1) Information on how to recognize the most common type of improper installation; and

(2) Information on the availability and responsibilities of independent (public or private) inspection services and the means of contacting these services.

(b) Pursuant to § 456.1021 each utility and participating home heating supplier shall submit to the Assistant Secretary for approval, the information to be provided to eligible customers required under paragraph (a) of this section.

(c) Any utility or participating home heating supplier may request an exception from the requirements of paragraph (a) of this section pursuant to § 456.1022. Such requests must demonstrate that existing mechanisms are sufficient to ensure reasonable levels of effectiveness and safety in the installation of measures.

§ 456.1014 Qualification procedures for auditors.

(a) Each utility and participating home heating supplier subject to the FSP must provide an adequate number of auditors for the RCS program who have successfully completed an auditor training program using either the DOE auditor training manual or any other DOE approved auditor training program or passed a DOE approved certification examination.

(b) Paragraph (a) of this section shall not applicable to any auditor who has previously operated under an approved RCS State Plan unless the utility or participating home heating supplier decides otherwise.

(c) Pursuant to § 456.1021, each utility and participating home heating supplier subject to the FSP shall provide to the Assistant Secretary for approval, procedures for training auditors, a description of the training materials, and a reasonable timetable for the implementation of the qualification procedures for auditors.

§ 456.1015 Home heating suppliers.

(a) *Participation and Withdrawal.* Any home heating supplier in a State subject to the RCS Federal Standby Plan wishing to participate in the Plan may contact the Assistant Secretary.

(1) Notwithstanding any other provision of this part, any participating home heating supplier may request a waiver of certain requirements in this Plan as provided in paragraph (b) of this section.

(2) Any participating home heating supplier may voluntarily withdraw from the FSP by submitting to the Assistant Secretary a written notification.

(3) Prior to withdrawal, the participating home heating supplier shall give notice of its withdrawal to those customers who have either requested RCS audits or otherwise have been involved in RCS services and shall refer them to the appropriate utility in the same service area.

(4) The withdrawal notice to the Assistant Secretary shall give assurance that the home heating supplier has performed the requirements in paragraph (a)(3) of this section.

(b) *Waiver of requirements.* (1) The Assistant Secretary will consider individual requests for waivers of FSP requirements from participating home heating suppliers on the basis of the limited resources of the home heating suppliers.

(2) The Assistant Secretary will not waive the following requirements for

any home heating supplier who chooses to participate in the program:

(i) Section 456.1003 (Investigation and enforcement).

(ii) Section 456.1007(d) (Prohibitions and disclosures required for program audits).

(iii) Section 456.1007(e) (Furnace audits).

§ 456.1016 Program measures.

(a)(1) Each utility or participating home heating supplier subject to the FSP may exclude any program measure for its service area on the following basis:

(i) When, by substituting utility or home heating supplier derived data, the program measure has a payback period (P) of more than seven years, as determined by dividing the installed first cost (F) less any Federal and State tax credit (T), by the first year energy savings in dollars (S),

$$P = \frac{F-T}{S} \quad P>7 \text{ years, and/or}$$

(ii) When, by substituting a utility or home heating supplier specific prototypical house, it is determined that the program measure has a payback period (P) of more than seven years pursuant to the formula in paragraph (a)(1)(i) of this section.

(2) The utility or participating home heating supplier shall provide to the Assistant Secretary data to substantiate any exclusion pursuant to paragraph (a)(1) (i) or (ii) of this section.

(b) The utility or participating home heating supplier may add, with DOE's approval, pursuant to § 456.1022, any measure not identified in Appendix I as a program measure for its service area, to the Plan.

§ 456.1017 Supply, installation and financing by utilities.

(a) *General.* Except as provided below, the provisions of the paragraphs (b)(2) (i)-(iii) of this section, shall be undertaken in a manner which minimizes the cost of residential energy conservation measures to such customers.

(b) *Exemption for utility subcontractor supply and installation.* The Assistant Secretary shall grant an exemption to the prohibition contained in § 456.502(a) to a utility to supply or install any energy conservation or renewable resource measure through contracts between such utility and independent suppliers or contractors where the customer requests such supply and installation and the following conditions are met:

(1) The utility certifies to DOE that each supplier or contractor;

(i) Shall not be subject to the control of the utility, except as to the performance or such contract and shall not be an affiliate or subsidiary of such utility and;

(ii) If selected by the utility, shall be selected in a manner consistent with paragraph (b)(2) of this section.

(2) The utility submits to DOE a description of the proposed utility activities which shall include evidence that such activities:

(i) Shall not involve unfair methods of competition;

(ii) Shall not have a substantial adverse effect on competition in the area in which such activities are undertaken nor result in providing to any supplier or contractor an unreasonably large share of contracts for the supply or installation of energy conservation or renewable resource measures;

(iii) Shall be undertaken in a manner that provides, subject to reasonable conditions to utility may establish to ensure the quality of supply and installation of energy conservation or renewable resource measures, that any financing by the utility of such measures shall be available to finance the supply or installation by any contractor or to finance the purchase of such measures to be installed by the customer; and

(iv) To the extent practicable and consistent with paragraphs (b)(2) (i)-(iii) of this section, shall be undertaken in a manner which minimizes the cost or residential energy conservation measures to such customers.

(3) Any covered utility wishing to obtain an exemption to the prohibition contained in § 456.502(a) shall

obtain approval by sending the request for exemption along with the required conditions and evidence described in paragraphs (b) (1) and (2) of this section to the Assistant Secretary for Conservation and Renewable Energy, Department of Energy, 1000 Independence Avenue, SW., Washington, DC 20585.

(4) Upon request, a utility conducting activities pursuant to this section shall provide DOE with a current estimate of the average price of supply and installation of energy conservation and renewable resource measures subject to the contracts entered into by the utility under paragraph (b) of this section.

§ 456.1018 Complaints processing procedures.

(a) *Conciliation services for customer complaints.* (1) Each utility or participating home heating supplier subject to the FSP is required at the time of the audit or with the audit results to offer to provide to eligible customers information on available conciliation services for the purpose of resolving complaints by eligible customers against persons who install or supply program measures under the RCS program.

(2) Each utility and participating home heating supplier shall establish procedures to resolve complaints by eligible customers against the utility or home heating supplier under the FSP.

(b) *Redress proceedings.* Each utility or participating home heating supplier subject to the FSP shall offer to provide to eligible customers, at the time of the audit or with the audit results, information on available redress proceedings for use by all persons alleging injury arising from an activity carried out under the FSP or from a violation of the FSP.

(c) *Additional requirement with respect to conciliation and redress.* Each utility or participating home heating supplier shall submit to the Assistant Secretary pursuant to § 456.1021, the information that will be made available to inform eligible customers of available conciliation services and redress proceedings. If such services are unavailable, the Assistant Secretary shall be notified and shall take appropriate action.

§ 456.1019 Coordination.

The Assistant Secretary shall contact annually the cognizant Federal, State, and local officials responsible for energy conservation programs within and affecting a State which is covered by the FSP.

§ 456.1020 Reporting and recordkeeping.

(a) Each utility and participating home heating supplier subject to the FSP shall submit a report to the Assistant Secretary no later than six months after the date of DOE approval of all procedures submitted pursuant to § 456.1021. An annual report shall subsequently be submitted no later than each July 1 and thereafter until July 1, 1989, unless the initial six month report is required to be submitted less than 90 days prior to July 1. In such a case, the annual report shall be submitted the following July 1 and annually thereafter through June 30, 1989.

(b) The six month report or annual report or both, as indicated, shall include the following information:

(1) The approximate number of eligible customers (6 month report only).

(2) A copy of the program announcement if not already provided (6 month report only).

(3) The number of program announcements provided to eligible customers, including the number of those making conditional audit offers (6 month report and annual report).

(4) The number of energy audits requested and provided.

(5) The nature of any direct financing activities and exempted or waived supply or installation activities engaged in by the utilities, including:

(i) Where applicable, any copy of any State or local law or regulation in effect on November 9, 1978 which requires or explicitly permits the utility to engage in any supply or installation of any energy conservation or renewable resource measures (6 month report);

(ii) The procedures used to select products to be supplied, installed, or financed (6 month report and annual report);

(iii) The procedures used to select installers to perform utility supported work (6 month report and annual report);

(iv) Steps the utility has taken to ensure that the activities have no adverse effect on competition (6 month report and annual report); and

(v) The price and interest rates charged by utilities in conjunction with the supply, installation and financing services offered pursuant to exemptions or waivers granted under section 216 (b), (c), (d)(1), (d)(2), and (e) of NECPA (6 month report and annual report).

(6) Description of the treatment of costs described in § 456.1010(b)(2) (utility only) (6 month report or annual report).

(7) The estimated utility or home heating supplier costs of implementing the RCS Program incurred during the reporting period (6 month report and annual report).

(8) The number and description of complaints against the utility or participating home heating supplier (6 month report and annual report).

(c) Each covered utility and participating home heating supplier shall keep for five years from the date of the program audit a copy of the audit report, and shall make such report available upon request to the Assistant Secretary.

(d) Any provisions of this section notwithstanding, the Assistant Secretary may, as he deems essential to the Departmental implementation of program responsibilities and subject to approval of the OMB under provisions of the Paperwork Act (Pub. L. 96-511)—

(1) Require additional information; or

(2) Waive any reporting and recordkeeping requirements, except the recordkeeping requirement in paragraph (c) of this section.

§ 456.1021 Information which a utility and participating home heating supplier shall report to the Assistant Secretary.

Utilities and participating home heating suppliers subject to the FSP shall report the following procedures to the Assistant Secretary for his approval on a date specified in the order.

(a) Procedures for determining the estimates of energy costs savings (§ 456.1006(b)).

(b) Procedures for ensuring that reasonable levels of effectiveness and safety are attained in the supply and installation of measures under the RCS Program (§ 456.1013(b)).

(c) Training procedures and a description of the training materials for auditors, including the timetable for the implementation of the qualification procedures for auditors § 456.1014(c)).

(d) The information to be offered to eligible customers on available conciliation services and redress proceedings §§ 456.1018(a)(1) and (b)).

(e) Procedures for handling complaints against a utility or participating home heating supplier (§ 456.1018(a)(2)).

§ 456.1022 Exceptions.

As provided for in the applicable sections, any utility or participating home heating supplier wishing to seek an exception from one or more of the following sections shall obtain approval from the Assistant Secretary by sending the request for approval, along with supporting documents, to the Assistant Secretary for Conservation and Renewable Energy, Department of Energy, 1000 Independence Avenue SW., Washington, DC 20585.

(a) Section 456.1000(c). (Exception for existing RCS programs);

(b) Section 456.1006(a)(2). (Listing substitute energy conserving practices in the program announcement);

(c) Section 456.1006(d). (Allowing advertising in the program announcement);

(d) Section 456.1007(a)(3). (Extending the time for the performance of an audit after a customer's request);

(e) Section 456.1007(b)(1). (Identifying substitute energy conserving practices during the program audit);

(f) Section 456.1007(b)(2). (Developing substitute applicability criteria);

(g) Section 456.1007(b)(3). (Developing substitute program audit procedures);

(h) Section 456.1007(e)(1). (Estimating costs or energy cost savings of installing any measure or product which is not a program measure);

(i) Section 456.1013(c). (Developing quality assurance procedures);

(j) Section 456.1016(a)(2). (Substantiating exclusion of program measures in calculating payback period); or

(k) Section 456.1016(b). (Adding program measures to the FSP not identified in Appendix I).

§ 456.1023 Waivers.

As provided for in Subpart L, any utility or participating home heating supplier wishing to petition for a waiver from any requirement under this subpart shall follow the procedures contained under section § 456.1203.

Subpart K—Alternative State Plans

§ 456.1101 Scope.

This subpart identifies the responsibilities of States and covered utilities under an Alternative State Plan authorized under section 103(a) of CSRA including the plan content, certification procedure, reporting requirements, enforcement procedures, and the amendment process.

§ 456.1102 Definitions.

(a) For purposes of this subpart, an "entity" means the Governor of any State or the designated State regulatory authority, or agency or instrumentality of the State authorized under State law to formulate and certify an alternative State plan for residential buildings under this subpart.

(b) "Covered utilities" are those regulated utilities which meet the definition of "covered utility" in § 456.105, and in addition, to the extent authorized by State law or agreed to by the organizations, includes non-regulated utilities and home heating suppliers. For purposes of this subpart, any utility with a retail service territory in more than one State shall be considered to be a separate utility with respect to each State in which its retail service territory is located.

§ 456.1103 Content of plan.

An alternative State plan certified pursuant to this subpart shall—

(a) Be designed to result in annual residential energy conservation savings of 2 percent or more.

(b) Contain the goals established for the plan and an analysis of the data and rationale used by the certifying entity to determine that the plan is likely to achieve such goals.

(c) Contain adequate procedures to assure that, if a public utility supplies or installs residential energy conservation measures, such actions shall be consistent with section 216 of NECPA and Subpart E of this part and prices and rates of interest charged shall be fair and reasonable.

(d) Contain adequate procedures for preventing unfair, deceptive, and anticompetitive acts or practices affecting commerce which relate to the implementation of such plan.

§ 456.1104 Incentives.

The entity in charge of a plan under this subpart, or a State regulatory authority, may, to the extent permitted under State law, provide incentives for utilities to meet the goals contained in the State's alternative State plan, including providing such utilities that meet or exceed such goals with a rate of return on expenditures made for the purpose of accomplishing such goals.

§ 456.1105 Certification process.

(a) *Certification.* (1) The entity which elects to certify a plan under this section shall certify, pursuant to a form prescribed by the Secretary (except as provided by paragraph (a)(2) of this section), to the Secretary that—

(i) The plan meets the requirements of § 456.1103;

(ii) The plan is likely to achieve the goals established for the plan if it is adequately implemented; and

(iii) The plan will be adequately implemented.

(2) If a form is not made available by the Secretary within 90 days after the date of the enactment of the CSRA and until such form is made available, the certifying entity may make such

certification on a form prescribed by such entity.

(3) Any certification under this section shall include a copy of the plan and a detailed explanation of the manner in which the contents of the plan will be implemented.

(b) *Consequences.* (1) Beginning with the certification date of a plan under this section and ending with the date on which a plan is no longer in effect—

(i) Subsections (a) through (c)(3) of section 212, sections 213 through 215 and sections 217 and 218 of NECPA shall not apply with respect to regulated utilities in such State and nonregulated utilities which are included in the plan; and

(ii) Section 219 of NECPA shall apply to utilities described in subparagraph (a) only to the extent provided for under § 456.1107.

(2) Except as provided under § 456.1108, any State for which a plan is certified under this section shall continue to have such plan in effect until June 30, 1989.

§ 456.1106 Reporting requirements.

(a) The certifying entity shall submit an annual report to the Secretary, within 60 days after the end of the 1-year period to which the report relates, describing the implementation of the plan and the results thereof.

(b) Such report shall include—

(1) A statement of the number of residential buildings receiving benefits under the plan;

(2) An estimate of the actual energy savings resulting from the plan and a description of sources of such savings;

(3) A statement of the percentage of individuals with low and moderate incomes who receive benefits under the plan;

(4) A detailed description of the benefits provided under the plan and of how the plan is implemented;

(5) Estimated State costs and utility costs of implementing the plan; and

(6) The names of the entities carrying out the plan.

(c) The first such report shall be made by the certifying entity within the 14-month period that begins with the plan certification date.

(d) Subject to approval of the Office of Management and Budget under the provisions of the Paperwork Reduction Act (Pub. L. 96-511), the Secretary may, to meet the requirements under section 225 of the NECPA, require additional information from entities.

§ 456.1107 Procedures for administrative and judicial enforcement.

(a) *Rights to petition.* At any time more than 1 year after an Alternative State plan has been certified under § 456.1105, any customer of a utility subject to such Alternative State plan may petition the Secretary of Energy to conduct a public hearing to determine if the Alternative State plan has been adequately implemented.

(b) *Content of petition.* Any petition mailed by the Secretary shall be received for filing only if such petition—

(1) Sets forth the petitioner's name and address;

(2) States that the petitioner is a customer of a named utility subject to an alternative State plan that was certified under § 456.1105 more than one year prior to the date of the petition;

(3) Explains how the alternative State plan has not been adequately implemented with sufficient specificity to give reasonable notice of any failure constituting grounds for complaint and any supporting allegations of relevant facts;

(4) States how the petitioner has been injured by any failure to adequately implement the alternative State plan stated as a ground for complaint;

(5) States whether and to what extent a hearing is desired;

(6) Contains a certificate verifying that a copy of the petition was transmitted, on the same date of transmittal to the Secretary to the entity which certified the alternative State plan, by certified mail, return-receipt requested; and

(7) Is signed by the petitioner before a Notary Public.

(c) *Answer.* The entity in charge of the alternative State plan shall have 20 days from the date of receipt to file an answer to the petition.

(d) *Denial of hearing.* Within 60 days of the date the petition is received for filing, the Secretary may deny a hearing, in whole or in part, in a written statement including supporting reasons if such a hearing is not justified in the public interest.

(e) *Prehearing dismissal.* Within 60 days after a petition is received for filing, the Secretary may dismiss such petition for failure to state adequate injury in fact or sufficient grounds for complaint which, if supported by the record, would warrant the conclusion that the alternative State plan has not been adequately implemented.

(f) *Notice of hearing.* Within 60 days of the date the petition is received for filing, the Secretary shall give advance notice to the public of any hearing to be carried out on a petition under this section including but not limited to—

(1) A description of the grounds for complaint in the petition;

(2) A date certain by which the public may submit written comments;

(3) Procedures for submission of evidence; and

(4) Such additional procedures as may be appropriate for the conduct of the hearing.

(g) *Making the determination.* Any determination by the Secretary concerning the adequacy of the implementation of any alternative State plan shall be on the record and shall be published in the FEDERAL REGISTER within 60 days after such determination is made.

(h) *Appeal.* Any person alleging that he is likely to be injured as a result of a determination by the Secretary under this section may, within 60 days after publication or notification of such determination, institute an action appealing the determination in the United States Court of Appeals for the appropriate judicial circuit. The court shall review the determination of the Secretary in accordance with Administrative Procedures Act, and shall have jurisdiction to affirm, modify, set aside, in whole or in part, or to remand such determination to the Secretary for such other action as the court may direct.

(i) *Enforcement.* Except as provided in paragraph (f) of this section, if any determination by the Secretary that the alternative State plan has not been adequately implemented becomes final and may not be appealed, the Secretary shall, within 30 days of the date on which the determination may no longer be appealed, initiate standby authority under Subpart J with respect to such State.

(j) *Exception.* If a State which had an approved plan in effect under subpart B on the day before the date on which certification was made under § 456.1105 informs the Secretary in writing, within 30 days after receiving a copy of the petition described in paragraph (a) of this section, that it will no longer implement a plan certified under this subpart and that it will implement the approved plan which was in effect in the State on the day before certification of the alternative State plan under this subpart, then—

(1) The determinations and actions described in paragraphs (b) through (d) of this section may not be carried out; and

(2) Sections 212 through 219 of NECPA shall apply in such State except to the extent that waivers are provided for utilities under Subpart L in such State.

§ 456.1108 Amendments.

(a) Except as provided by paragraph (b) of this section, a plan certified under this subpart may be amended by any amendment—

(1) Consistent with the requirements of § 456.1103; and

(2) Certified to the Secretary of Energy in a manner consistent with the requirements applicable to the certification of a plan under § 456.1104.

(b) A plan certified under this subpart may not be amended—

(1) During the first year after it is certified; or

(2) More than once a year thereafter.

Subpart L—Utility Waiver Process

§ 456.1201 Scope.

This subpart specifies the procedures to be followed by covered utilities to request a waiver from the Secretary from any provision of this part or any provision of a State residential energy conservation program under this part. For purposes of this section, the term "residential energy conservation program" means any program carried out by a utility that has as its purpose—

(a) Increasing the efficiency with which petroleum, natural gas or electric energy is consumed in residential buildings served by such utility; or

(b) Utilizing solar or other forms of renewable energy in residential buildings served by such utility.

§ 456.1202 Coverage.

This subpart shall apply to all regulated and nonregulated utilities which meet the definition of "covered utility" in § 456.105.

§ 456.1203 Approval process.

(a) *Criteria.* A waiver may be approved under this subpart if a covered utility shows in appropriate State proceedings and the appropriate State officials find that—

(1) The existing and planned residential energy conservation programs that will be implemented by the utility if a waiver from such provision is approved will result in savings in petroleum, natural gas or electric energy consumed in residential buildings served by the utility that are equal to or greater than the savings that would be achieved in connection with a properly implemented State residential conservation service plan under this part; and

(2) Adequate procedures are in effect that prevent unfair, deceptive or anticompetitive acts or practices affecting commerce that relate to the implementation of such residential energy conservation programs, including provisions to assure that any person who alleges any injury resulting from unfair, deceptive or anticompetitive acts or practices in connection with such programs shall be entitled to redress under such procedures as may be established by the Governor in the State in which the utility provides the service.

(b) *Approval.* The Secretary shall approve a request of a utility for a waiver under paragraph (a) of this section if the Secretary determines that—

(1) Opportunity for a hearing on the request for a waiver has been provided in the State in which the utility provides utility service; and

(2) In the case of a regulated utility, the Governor of the State in which the utility provides utility service and the State regulatory authority that has ratemaking authority with respect to such utility both—

(i) Find that the showings under paragraphs (a) (1) and (2) of this section are sufficient; and

(ii) Support the request by the utility for the waiver.

(3) In the case of a nonregulated utility, the Governor of the State in which the utility provides utility service—

(i) Finds that the showings under paragraphs (a) (1) and (2) of this section are sufficient; and

(ii) Supports the request by the utility for the waiver.

(c) *Submittal.* (1) Utilities seeking a waiver shall prepare a request documenting their proposal and showing how the approval criteria of § 456.1203(a) are met. The request shall be submitted to the Governor and, in the case of regulated utilities, to the State regulatory authority.

(2) The Governor, and, in the case of regulated utilities, the State regulatory authority, shall, for those waiver requests supported, submit to the Assistant Secretary a statement concerning the opportunity for a hearing on the request and a brief summary of findings concerning the sufficiency of the utility showings regarding the criteria in paragraphs (a) (1) and (2) of this section together with the utility waiver request.

§ 456.1204 Annual Report to Governor.

Any utility that receives a waiver under this section shall provide the Governor of the State in which that utility provides utility service with an annual report describing the performance of its residential energy conservation programs in relation to the showings of such utility under paragraphs (a)(1) and (2) of this section.

§ 456.1205 Revocation procedures.

(a) The Secretary shall revoke any waiver granted to a covered utility subject to a State plan under this subpart upon a request under this section by the Governor of the State in which the utility provides utility service.

(b) The Governor, with the concurrence of the State regulatory authority in the case of a regulated utility, may request such a revocation on the basis that the savings described under § 456.1203(a)(1) on an annual basis are less than the savings in the year prior to approval of the waiver or that the procedures specified under § 456.1203(a)(2) are no longer adequate.

(c) A request for revocation may be made only after a review and opportunity for public hearing on the performance of the residential energy conservation programs of the utility. In order to facilitate such review and hearing, the utility shall provide the Governor such information as the Governor requests about such residential energy conservation program.

(d) The revocation request submitted to the Secretary shall contain a statement concerning the review and hearing discussed in paragraph (c) of this section, and a brief summary of the findings leading to the request to paragraph (b) of this section.

Subpart M—Commercial Buildings and Multifamily Dwellings

§ 456.1301 Scope.

This subpart applies to any State energy conservation plan for commercial buildings and multifamily dwellings approved under section 721 of the National Energy Conservation Policy Act before August 1, 1984.

§ 456.1302 Authority to continue plans.

Any State energy conservation plan to which this subpart applies may, with respect to regulated utilities, continue in effect until January 1, 1990.

§ 456.1303 Reporting.

The administering agency for any State energy conservation plan to which this subpart applies may report annually at such time as may be appropriate with respect to activities carried out under the authority of section 201 of CSRA.

APPENDIX I TO PART 456—PROGRAM MEASURES

(a) *General.* (1) The measures table was developed by evaluating program measures with respect to a prototypical house (see Appendix II) for all HUD/MPS climate zones and categories of residential fuel use. A measure was determined to be a program measure for a climate zone and category of residential fuel use if the ratio of installed first cost, less any Federal and State income tax credits, divided by first year energy savings in dollars was less than or equal to 7 years. The RCS Model Audit procedures were used to determine energy savings.

(2) DOE applied only resident-installed costs to those measures which are not likely to be installed by a contractor: caulking and weatherstripping. Resident-installed and contractor costs were used to determine installed first cost for those measures which DOE believes could be easily installed by homeowners without encountering safety hazards or without conflicting with most building code requirements. These measures include ceiling insulation, floor insulation, water heater insulation, clock thermostats, heat reflective and heat absorbing window and door materials, and pipe and duct insulation. Contractor-installed costs alone were used for those measures where local codes or regulations and safety considerations are likely to preclude homeowner installations or where a measure is not easily installed by a homeowner. These measures include: wall insulation, storm and thermal windows and doors, replacement heating systems, oil burner replacements, vent dampers, intermittent ignition devices (IID's), replacement central air-conditioners, active solar space heating systems, combined active solar space heating and hot water heating systems, solar domestic water heating systems, replacement solar pool heaters, and wind energy devices.

(b) *Climate Zones of Program Measures.* In the table of program measures, the climate zones for heating degree-days are as follows:

Climate	Heating degree-days
1	0 to 1000.
2	1001 to 2500.
3	2501 to 3500.
4	3501 to 4500.
5	4501 to 5000.
6	5001 to 6000.
7	6001 to 7000.

Climate	Heating degree-days
8	7001 and above.

The cooling degree-days utilized in the evaluation of program measures for each climate zone within each State are the cooling degree-days for the weather station which is specified for that climate zone in the DOE Model Audit.

(c) *Category of Residential Fuel Use.* The program measures are designated in the following tables by categories of residential fuel use. These categories are:

(1) For ceiling insulation, wall insulation, floor insulation, duct insulation, pipe insulation, storm or thermal windows, storm or thermal doors, replacement heating systems, replacement oil burners, vent dampers, IID's, active solar space heating systems, and combined solar space heating and solar domestic hot water systems:

(i) "Electricity," which includes all residential buildings in which the principal source of space heating is an electric resistance heating system;

(ii) "Gas," which includes all residential buildings in which either natural gas, or propane, or butane is the principal space heating fuel;

(iii) "Oil," which includes all residential buildings in which either #2 heating oil or kerosene is the principal space heating fuel and includes all other residential buildings not included in the categories "Electricity," "Gas," or "Heat Pump";

(iv) "Heat Pump," which includes all residential buildings in which the principal source of space heating is an electric heat pump.

(2) For water heater insulation and solar domestic hot water:

(i) "Electricity" includes all residential buildings in which the principal fuel for water heating is electricity;

(ii) "Gas" includes all residential buildings in which the principal fuel for water heating is either natural gas, or propane, or butane;

(iii) "Oil" includes all residential buildings for which the principal fuel for water heating is either #2 heating oil, kerosene, or a fuel not included under "Electricity" or "Gas" in this subsection.

(3) For heat reflective and heat absorbing window and door material, "Electricity" includes all residential buildings in which electricity is used for air-conditioning and includes buildings that are cooled with a heat pump.

(4) For replacement central air-conditioners, "Electricity" includes all residential buildings in which electricity is used by a central air-conditioner.

(5) For replacement solar swimming pool heaters:

(i) "Electricity" includes all swimming pools for which the principal fuel for pool heating is electricity;

(ii) "Gas" includes all swimming pools for which the principal fuel for pool heating is natural gas, or propane, or butane;

(iii) "Oil" includes all swimming pools for which the principal fuel for pool heating is either #2 heating oil, kerosene, or a fuel not included under "Electricity" or "Gas" in this subsection.

(6) For wind energy devices:

(i) "Electricity" includes all residences in which the principal source of space heating is an electric resistance heating system and which have electric domestic water heating.

(ii) "Heat Pump" includes all residences in which the principal source of space heating is an electric heat pump and which have electric domestic hot water heating.

(d)(1) *Caulking, Weatherstripping, and Clock Thermostats.* Caulking and weatherstripping fell within the 7-year payback in all climate zones for all fuel use categories for resident-installed costs and are considered program measures in all States. Clock thermostats fell within the 7-year payback in all climate zones for all fuel use categories for resident- and contractor-installed costs. (For the sake of simplicity, these measures do not appear in the tables.)

(2) *Devices Associated with Electric Load Management Techniques.* Devices associated with electric load management techniques are program measures for all categories of fuel use if the local electric utility offers a residential rate that reflects any differences in the utility's cost of service (either energy or demand costs) between peak and off-peak periods, or if a residential electric rate comprised of an integrated peak measured demand and an energy use component is applied.

(3) *Ceiling Insulation.* Where indicated as a program measure in Table 2, the R-Value for ceiling insulation shall be determined by the State.

(4) *Floor Insulation.* Where indicated as a program measure in Table 2, the R-Value for floor insulation shall be determined by the State.

(5) *Replacement Solar Swimming Pool Heaters.* These are evaluated as a program measure as indicated in Table 2. This analysis assumed a pool blanket or cover is also used. The measure should be audited for as indicated in Table 2 whenever the residence has a heated pool.

(6) *Intermittent Ignition Devices (IID's).* IID's are not displayed as program measures in Table 2, but are program measures for the category "Gas" in the Oregon climate zone "8."

(7) *Active Solar Space Heating Systems and Combined Solar Space Heating and Hot Water Systems.* Active solar space heating systems and combined solar space heating and hot water systems are program measures as indicated by Table 1 below.

TABLE 1

State	HUD/MPS region	Fuel	Active solar systems	Combined[1]
zona	3	Electric	C	C.
		Gas		
		Oil		
		H.P.		
zona	4	Electric	C	C.
		Gas	[C]	
		Oil	C	
		H.P.	[C]	
fornia	3	Electric		C.
		Gas		
		Oil		
		H.P.		
w Mexico	3	Electric	C	C.
		Gas		
		Oil		
		H.P.		
w Mexico	4	Electric	C	C.
		Gas		
		Oil		
		H.P.	[C]	
w Mexico	5	Electric	C	
		Gas		
		Oil		
		H.P.		

[1] Combined solar space heating and hot water systems.

(8) *Wind Energy Devices.* A State that does not change its audit requirements by deleting measures based on the amended RCS measures table shall, whenever a wind energy device appears in Table 2 with brackets and is also asterisked, continue to include a wind energy device as a program measure in its State Plan. Whenever a wind energy device is bracketed or bracketed and asterisked, a State that changes its audit requirements by deleting measures based on the amended RCS measures table shall include in its State Plan the requirement that utilities audit for the appropriate type of wind energy device identified in Table 2. Where both types of wind energy devices are identified in Table 2, an audit is required for only one of these devices.

(e) *Bracketed Measures.* A State is required to include in its State Plan those measures that appear in brackets in Table 1 or 2 only when a State changes its audit requirements by deleting any measures from its State Plan based upon the amended RCS measures tables.

(f) *Table of Program Measures by State.* All other program measures are displayed in Table 2 organized by State where:

R = Resident-installed costs
C = Contractor-installed costs
X = 2-kW nonutility interconnected DC wind machine without battery storage
Y = 2-kW interconnected AC wind machine without battery storage.

TABLE 2

State	HUD/MPS region fuel	Insulation						Storm or thermal windows	Storm or thermal doors	Heat reflective and absorbing window materials	Replacement heating system	Replacement oil burner	Vent damper	Replacement central air conditioner	Solar domestic water heater	Replacement solar pool heater	Wind energy
		Ceiling	Wall	Floor	Water heater	Duct	Pipe										
AL	2																
	Electric	RC	C	[RC]	RC	RC	RC			RC				C		C	
	Gas	RC		[RC]	RC	R	RC						C				
	Oil	RC	C	[RC]	RC	RC	RC					C				C	
	H.P.	RC		[R]		R	R									C	
AL	3																
	Electric	RC	C	RC	RC	RC	RC	C		RC	C			C			
	Gas	RC	C	[RC]	RC	RC	RC				C		C				
	Oil	RC	C	[RC]	RC	RC	RC	[C]				C					
	H.P.	RC	C	[RC]		RC	RC										
AK	6																
	Electric	RC	C	RC		RC	RC	C		RC							
	Gas	RC	C	RC		RC	RC				C		C				
	Oil	RC	C	RC		RC	RC	C			C	C					
	H.P.	RC	C	RC		RC	RC	C									
AZ	1																
	Electric	RC	C	[R]	RC	R	R	[C]		RC				C			
	Gas	RC	C	[R]	RC	R	R	[C]									
	Oil	RC	C	[R]	RC	R	R	[C]									
	H.P.	RC	C			R	R	[C]									
AZ	2																
	Electric	RC	C	[RC]	RC	RC	RC	C		RC	C			C			
	Gas	RC	C	[RC]	RC	RC	RC	[C]			C		C				
	Oil	RC	C	[RC]	RC	RC	RC	[C]				C					
	H.P.	RC	C	[RC]		RC	RC	[C]									
AZ	3																
	Electric	RC	C	RC	RC	RC	RC	C	[C]	RC	C			C			[X]
	Gas	RC	C	[RC]	RC	RC	RC	[C]			C		C				
	Oil	RC	C	[RC]	RC	RC	RC	[C]				C					
	H.P.	RC	C	[RC]		RC	RC	[C]									[X]
AZ	4																
	Electric	RC	C	RC	RC	RC	RC	C	[C]	RC	C			C			
	Gas	RC	C	RC	RC	RC	RC	C			C		C				
	Oil	RC	C	RC	RC	RC	RC	C				C					
	H.P.	RC	C	RC		RC	RC	C									
AZ	5																
	Electric	RC	C	RC	RC	RC	RC	C		RC	C				C	C	
	Gas	RC	C	RC	RC	RC	RC	C			C		C			C	

	Oil	RC	C	RC	RC	RC	RC	C			C	C				C
	H.P.	RC	C	RC		RC	RC	C								C
AZ	6															
	Electric	RC	C	RC	RC	RC	RC	C	C	RC	C			C	C	
	Gas	RC	C	RC	RC	RC	RC	C			C		C			
	Oil	RC	C	RC	RC	RC	RC	C			C	C				
	H.P.	RC	C	RC		RC	RC	C								
AZ	7															
	Electric	RC	C	RC	RC	RC	RC	C		RC	C				C	C
	Gas	RC	C	RC	RC	RC	RC	C			C		C			
	Oil	RC	C	RC	RC	RC	RC	C			C	C				
	H.P.	RC	C	RC		RC	RC	C								C
AR	3															
	Electric	RC	C	RC	RC	RC	RC	C		RC	C			C		
	Gas	RC	C	[R]	RC	R	R									
	Oil	RC	C	[RC]	RC	RC	RC	[C]				C				
	H.P.	RC	C	[RC]		RC	RC	[C]								
AR	4															
	Electric	RC	C	RC	RC	RC	RC	C		RC	C			C		
	Gas	RC	C	RC	RC	RC	RC						C			
	Oil	RC	C	RC	RC	RC	RC	C				C				
	H.P.	RC	C	RC		RC	RC	C								
CA	2															
	Electric	RC	C	[RC]	RC	RC	RC	C		RC	C			C		
	Gas	RC	C	[RC]	RC	RC	RC	[C]					C			
	Oil	RC	C	[RC]	RC	RC	RC	[C]				C				
	H.P.	RC	C	[RC]		RC	RC	[C]								
CA	3															
	Electric	RC	C	RC	RC	RC	RC	C		RC	C			C		
	Gas	RC	C	[RC]	RC	RC	RC				C		C			
	Oil	RC	C	[RC]	RC	RC	RC	[C]				C				
	H.P.	RC	C	[RC]		RC	RC									
CA	4															
	Electric	RC	C	RC	RC	RC	RC	C		RC	C			C		
	Gas	RC	C	RC	RC	RC	RC	C			C		C			
	Oil	RC	C	RC	RC	RC	RC	C				C				
	H.P.	RC	C	RC		RC	RC	C								
CA	5															
	Electric	RC	C	RC	RC	RC	RC	C		RC	C			C		
	Gas	RC	C	RC	RC	RC	RC	C			C		C			
	Oil	RC	C	RC	RC	RC	RC	C			C	C				
	H.P.	RC	C	RC		RC	RC	C								
CA	6															
	Electric	RC	C	RC	RC	RC	RC	C		RC	C			C		
	Gas	RC	C	RC	RC	RC	RC	C			C		C			
	Oil	RC	C	RC	RC	RC	RC	C			C	C				
	H.P.	RC	C	RC		RC	RC	C								
CA	7															
	Electric	RC	C	RC	RC	RC	RC	C		RC	C				C	
	Gas	RC	C	RC	RC	RC	RC	C			C		C			

TABLE 2—Continued

State	HUD/MPS region fuel	Insulation						Storm or thermal windows	Storm or thermal doors	Heat reflective and absorbing window materials	Replacement heating system	Replacement oil burner	Vent damper	Replacement central air conditioner	Solar domestic water heater	Replacement solar pool heater	Wind energy
		Ceiling	Wall	Floor	Water heater	Duct	Pipe										
	Oil	RC	C	RC	RC	RC	RC	C			C	C					
	H.P.	RC	C	RC		RC	RC	C									
CA	8																
	Electric	RC	C	RC	RC	RC	RC	C		RC						C	
	Gas	RC	C	RC	RC	RC	RC	C			C		C				
	Oil	RC	C	RC	RC	RC	RC	C			C	C					
	H.P.	RC	C	RC		RC	RC	C								C	
CO	6																
	Electric	RC	C	RC	RC	RC	RC	C		RC	C			C	C	C	
	Gas	RC	C	RC	RC	RC	RC	C			C		C				
	Oil	RC	C	RC	RC	RC	RC	C			C	C				C	
	H.P.	RC	C	RC		RC	RC	C								C	
CO	7																
	Electric	RC	C	RC	RC	RC	RC	C		RC	C				C		
	Gas	RC	C	RC	RC	RC	RC	C			C		C				
	Oil	RC	C	RC	RC	RC	RC	C			C	C					
	H.P.	RC	C	RC		RC	RC	C									
CO	8																
	Electric	RC	C	RC	RC	RC	RC	C		RC					C	C	[XV]
	Gas	RC	C	RC	RC	RC	RC	C			C		C				
	Oil	RC	C	RC	RC	RC	RC	C			C	C					
	H.P.	RC	C	RC		RC	RC	C								C	[XV]
CT	6																
	Electric	RC	C	RC	RC	RC	RC	C		RC	C					C	[X]*
	Gas	RC	C	RC	RC	RC	RC	C			C		C				
	Oil	RC	C	RC	RC	RC	RC	C			C	C					
	H.P.	RC	C	RC		RC	RC	C								C	[X]*
DE	4																
	Electric	RC	C	RC	RC	RC	RC	C		RC	C					C	
	Gas	RC	C	RC	R	RC	RC	C			C		C				
	Oil	RC	C	RC	RC	RC	RC	C				C					
	H.P.	RC	C	RC		RC	RC	C								C	
DC	4																
	Electric	RC	C	RC	RC	RC	RC	C		RC	C			C		C	
	Gas	RC	C	RC	RC	RC	RC	C			C		C				
	Oil	RC	C	RC	RC	RC	RC	C				C					
	H.P.	RC	C	RC		RC	RC	C								C	
FL	1																

	Electric	RC	C	[illegible]	RC	R	R	(C)		RC				C		C	
	Gas	RC	C		RC	R	R										
	Oil	RC	C	(R)	RC	R	R	(C)								C	
	H.P.	RC	C			R	R									C	
FL	2																
	Electric	RC	C	(RC)	RC	RC	RC	C		RC	C			C		C	
	Gas	RC	C	(RC)	RC	R	RC						C				
	Oil	RC	C	(RC)	RC	RC	RC	(C)				C					
	H.P.	RC	C	(RC)		R	R									C	
GA	2																
	Electric	RC	C	(RC)	RC	RC	RC	C		RC				C		C	
	Gas	RC	C	(R)	RC	R	R										
	Oil	RC	C	(RC)	RC	RC	RC	(C)				C					
	H.P.	RC	C	(R)		R	R									C	
GA	3																
	Electric	RC	C	RC	RC	RC	RC	C		RC	C			C		C	
	Gas	RC	C	(RC)	RC	RC	RC						C				
	Oil	RC	C	(RC)	RC	RC	RC	(C)				C				C	
	H.P.	RC	C	(RC)		RC	RC									C	
GA	4																
	Electric	RC	C	RC	RC	RC	RC	C		RC	C					C	
	Gas	RC	C	RC	RC	RC	RC				C		C				
	Oil	RC	C	RC	RC	RC	RC	C				C					
	H.P.	RC	C	RC		RC	RC									C	
HI	1																
	Electric	RC	C	(RC)	RC	RC	RC	(C)	(C)	RC				C			(xy)*
	Gas	RC	C	(RC)	RC	RC	RC	(C)	(C)				C				
	Oil	RC	C	(R)	RC	R	R	(C)	(C)								
	H.P.	RC	C	(R)		R	R	(C)	(C)								(xy)*
ID	7																
	Electric	RC	C	RC	RC	RC	RC			RC							
	Gas	RC	C	RC	RC	RC	RC	C			C		C				
	Oil	RC	C	RC	RC	RC	RC	C			C	C					
	H.P.	RC	C	RC		RC	RC										
ID	8																
	Electric	RC	C	RC	RC	RC	RC	C		RC							
	Gas	RC	C	RC	RC	RC	RC	C			C		C				
	Oil	RC	C	RC	RC	RC	RC	C			C	C					
	H.P.	RC	C	RC		RC	RC										
IL	4																
	Electric	RC	C	RC	RC	RC	RC	C		RC	C			C		C	
	Gas	RC	C	RC	RC	RC	RC				C		C				
	Oil	RC	C	RC	RC	RC	RC	C				C					
	H.P.	RC	C	RC		RC	RC	C								C	
IL	5																
	Electric	RC	C	RC	RC	RC	RC	C		RC	C			C			
	Gas	RC	C	RC	RC	RC	RC	C			C		C				
	Oil	RC	C	RC	RC	RC	RC	C			C	C					
	H.P.	RC	C	RC		RC	RC	C									
IL	6																

TABLE 2—Continued

State	HUD/MPS region fuel	Insulation						Storm or thermal windows	Storm or thermal doors	Heat reflective and absorbing window materials	Replacement heating system	Replacement oil burner	Vent damper	Replacement central air conditioner	Solar domestic water heater	Replacement solar pool heater	Wind energy
		Ceiling	Wall	Floor	Water heater	Duct	Pipe										
	Electric	RC	C	RC	RC	RC	RC	C		RC	C					C	
	Gas	RC	C	RC	RC	RC	RC	C			C		C				
	Oil	RC	C	RC	RC	RC	RC	C			C	C					
	H.P.	RC	C	RC		RC	RC	C								C	
IL	7																
	Electric	RC	C	RC	RC	RC	RC	C		RC	C					C	
	Gas	RC	C	RC	RC	RC	RC	C			C		C				
	Oil	RC	C	RC	RC	RC	RC	C			C	C					
	H.P.	RC	C	RC		RC	RC	C								C	
IN	4																
	Electric	RC	C	RC	RC	RC	RC	C		RC	C					C	
	Gas	RC	C	RC	RC	RC	RC				C		C				
	Oil	RC	C	RC	RC	RC	RC	C				C					
	H.P.	RC	C	RC		RC	RC									C	
IN	5																
	Electric	RC	C	RC	RC	RC	RC	C		RC	C						
	Gas	RC	C	RC	RC	RC	RC				C		C				
	Oil	RC	C	RC	RC	RC	RC	C			C	C					
	H.P.	RC	C	RC		RC	RC	C									
IN	6																
	Electric	RC	C	RC	RC	RC	RC	C		RC	C						
	Gas	RC	C	RC	RC	RC	RC				C		C				
	Oil	RC	C	RC	RC	RC	RC	C			C	C					
	H.P.	RC	C	RC		RC	RC	C									
IN	7																
	Electric	RC	C	RC	RC	RC	RC	C		RC	C						
	Gas	RC	C	RC	R	RC	RC	C			C		C				
	Oil	RC	C	RC	RC	RC	RC	C			C	C					
	H.P.	RC	C	RC		RC	RC	C									
IA	6																
	Electric	RC	C	RC	RC	RC	RC	C		RC	C					C	
	Gas	RC	C	RC	RC	RC	RC	C			C		C				
	Oil	RC	C	RC	RC	RC	RC	C			C	C					
	H.P.	RC	C	RC		RC	RC	C								C	
IA	7																
	Electric	RC	C	RC	RC	RC	RC	C		RC						C	
	Gas	RC	C	RC	RC	RC	RC	C			C		C				
	Oil	RC	C	RC	RC	RC	RC	C				C					

	H.P.	RC	C	RC		RC	RC	C								C	
IA	8									RC						C	
	Electric	RC	C	RC	RC	RC	RC	C			C		C				
	Gas	RC	C	RC	RC	RC	RC	C			C	C					
	Oil	RC	C	RC	RC	RC	RC	C								C	
	H.P.	RC	C	RC		RC	RC	C									
KS	4									RC	C						
	Electric	RC	C	RC	RC	RC	RC	C					C				
	Gas	RC	C	RC	RC	RC	RC					C					
	Oil	RC	C	RC	RC	RC	RC	C									
	H.P.	RC	C	RC		RC	RC	C									
KS	5									RC	C			C	C		
	Electric	RC	C	RC	RC	RC	RC	C					C				
	Gas	RC	C	RC	RC	RC	RC	C			C	C					
	Oil	RC	C	RC	RC	RC	RC	C									
	H.P.	RC	C	RC		RC	RC	C									
KS	6									RC	C			C	C		[X]*
	Electric	RC	C	RC	RC	RC	RC	C			C		C				
	Gas	RC	C	RC	RC	RC	RC				C	C					
	Oil	RC	C	RC	RC	RC	RC	C									[X]*
	H.P.	RC	C	RC		RC	RC	C									
KS	7									RC	C			C	C		[X]*
	Electric	RC	C	RC	RC	RC	RC	C			C		C				
	Gas	RC	C	RC	RC	RC	RC	C			C	C					
	Oil	RC	C	RC	RC	RC	RC	C									[X]*
	H.P.	RC	C	RC		RC	RC	C									
KY	4									RC	C						
	Electric	RC	C	RC	RC	RC	RC	C					C				
	Gas	RC		RC	RC	RC	RC					C					
	Oil	RC	C	RC	RC	RC	RC	C									
	H.P.	RC	C	RC		RC	RC										
KY	5									RC	C						
	Electric	RC	C	RC	RC	RC	RC	C					C				
	Gas	RC		RC	R	RC	RC				C	C					
	Oil	RC	C	RC	RC	RC	RC	C									
	H.P.	RC	C	RC		RC	RC										
KY	6									RC	C						
	Electric	RC	C	RC	RC	RC	RC	C			C		C				
	Gas	RC		RC	R	RC	RC				C	C					
	Oil	RC	C	RC	RC	RC	RC	C									
	H.P.	RC	C	RC		RC	RC										
LA	2									RC	C			C		C	
	Electric	RC	C	[RC]	RC	RC	RC	C									
	Gas	RC	C	[R]	RC	RC	R					C					
	Oil	RC	C	[RC]	RC	RC	RC	[C]								C	
	H.P.	RC	C	[RC]		RC	RC										
LA	3									RC	C			C			
	Electric	RC	C	RC	RC	RC	RC	C					C				
	Gas	RC	C	[RC]	RC	RC	RC	[C]				C					
	Oil	RC	C	[RC]	RC	RC	RC	[C]									

TABLE 2—Continued

State	HUD/MPS region fuel	Insulation						Storm or thermal windows	Storm or thermal doors	Heat reflective and absorbing window materials	Replacement heating system	Replacement oil burner	Vent damper	Replacement central air conditioner	Solar domestic water heater	Replacement solar pool heater	Wind energy
		Ceiling	Wall	Floor	Water heater	Duct	Pipe										
	H.P.	RC	C	[RC]		RC	RC	[C]									
ME	8																
	Electric	RC	C	RC	RC	RC	RC	C		RC							[X]*
	Gas	RC	C	RC	R	RC	RC	C			C		C				
	Oil	RC	C	RC	R	RC	RC	C			C	C					
	H.P.	RC	C	RC		RC	RC	C									[X]*
MD	4																
	Electric	RC	C	RC	RC	RC	RC	C		RC	C			C		C	
	Gas	RC	C	RC	RC	RC	RC	C			C		C				
	Oil	RC	C	RC	RC	RC	RC	C				C					
	H.P.	RC	C	RC		RC	RC	C								C	
MD	5																
	Electric	RC	C	RC	RC	RC	RC	C		RC	C					C	
	Gas	RC	C	RC	R	RC	RC	C			C		C				
	Oil	RC	C	RC	RC	RC	RC	C			C	C					
	H.P.	RC	C	RC		RC	RC	C								C	
MD	6																
	Electric	RC	C	RC	RC	RC	RC	C		RC	C					C	
	Gas	RC	C	RC	RC	RC	RC	C			C		C				
	Oil	RC	C	RC	RC	RC	RC	C			C	C					
	H.P.	RC	C	RC		RC	RC	C								C	
MA	6																
	Electric	RC	C	RC	RC	RC	RC	C	C	RC	C					C	[X]*
	Gas	RC	C	RC	RC	RC	RC	C			C		C				
	Oil	RC	C	RC	RC	RC	RC	C			C	C					
	H.P.	RC	C	RC		RC	RC	C								C	[X]*
MA	7																
	Electric	RC	C	RC	RC	RC	RC	C		RC	C					C	
	Gas	RC	C	RC	R	RC	RC	C			C		C				
	Oil	RC	C	RC	RC	RC	RC	C			C	C					
	H.P.	RC	C	RC		RC	RC	C								C	
MI	7																
	Electric	RC	C	RC	RC	RC	RC	C		RC	C					C	
	Gas	RC	C	RC	R	RC	RC	C			C		C				
	Oil	RC	C	RC	RC	RC	RC	C			C	C					
	H.P.	RC	C	RC		RC	RC	C								C	
MI	8																
	Electric	RC	C	RC	RC	RC	RC	C		RC						C	

	Gas	RC	C	RC	R	RC	RC	C			C		C			
	Oil	RC	C	RC	RC	RC	RC	C			C	C				
	H.P	RC	C	RC		RC	RC	C								C
MN	8															
	Electric	RC	C	RC	RC	RC	RC	C		RC						
	Gas	RC	C	RC	R	RC	RC	C			C		C			
	Oil	RC	C	RC	RC	RC	RC	C			C	C				
	H.P	RC	C	RC		RC	RC	C								
MS	2															
	Electric	RC	C	[RC]	RC	RC	RC			RC				C		
	Gas	RC		[R]	RC	R	R									
	Oil	RC	C	[RC]	RC	RC	RC					C				
	H.P	RC	C	[R]		R	R									
MS	3															
	Electric	RC	C	RC	RC	RC	RC	C		RC	C			C		
	Gas	RC	C	[RC]	RC	RC	RC						C			
	Oil	RC	C	[RC]	RC	RC	RC	[C]				C				
	H.P	RC	C	[RC]		RC	RC									
MO	4															
	Electric	RC	C	RC	RC	RC	RC	C		RC	C			C		C
	Gas	RC	C	RC	RC	RC	RC	C			C		C			
	Oil	RC	C	RC	RC	RC	RC	C				C				
	H.P	RC	C	RC		RC	RC	C								C
MO	5															
	Electric	RC	C	RC	RC	RC	RC	C		RC	C			C		
	Gas	RC	C	RC	RC	RC	RC	C			C		C			
	Oil	RC	C	RC	RC	RC	RC	C			C	C				
	H.P	RC	C	RC		RC	RC	C								
MO	6															
	Electric	RC	C	RC	RC	RC	RC	C		RC	C			C		
	Gas	RC	C	RC	RC	RC	RC	C			C		C			
	Oil	RC	C	RC	RC	RC	RC	C			C	C				
	H.P	RC	C	RC		RC	RC	C								
MT	8															
	Electric	RC	C	RC	RC	RC	RC	C		RC						
	Gas	RC	C	RC	R	RC	RC				C		C			
	Oil	RC	C	RC	RC	RC	RC	C			C	C				
	H.P	RC	C	RC		RC	RC	C								
NB	6															
	Electric	RC	C	RC	RC	RC	RC	C		RC	C			C		
	Gas	RC	C	RC	RC	RC	RC	C			C		C			
	Oil	RC	C	RC	RC	RC	RC	C			C	C				
	H.P	RC	C	RC		RC	RC	C								
NB	7															
	Electric	RC	C	RC	RC	RC	RC	C		RC	C					
	Gas	RC	C	RC	RC	RC	RC				C		C			
	Oil	RC	C	RC	RC	RC	RC	C			C	C				
	H.P	RC	C	RC		RC	RC	C								
NB	8															
	Electric	RC	C	RC	RC	RC	RC	C		RC						C

TABLE 2—Continued

State	HUD/MPS region fuel	Insulation						Storm or thermal windows	Storm or thermal doors	Heat reflective and absorbing window materials	Replacement heating system	Replacement oil burner	Vent damper	Replacement central air conditioner	Solar domestic water heater	Replacement solar pool heater	Wind energy
		Ceiling	Wall	Floor	Water heater	Duct	Pipe										
	Gas	RC	C	RC	R	RC	RC				C		C				
	Oil	RC	C	RC	RC	RC	RC	C			C	C					
	H.P	RC	C	RC		RC	RC	C									
NV	2															C	
	Electric	RC	C	[RC]	RC	RC	RC			RC	C						
	Gas	RC		[RC]	RC	RC	RC										
	Oil	RC	C	[RC]	RC	RC	RC						C				
	H.P	RC		[RC]		R	RC					C					
NV	3																
	Electric	RC	C	RC	RC	RC	RC	C		RC	C						
	Gas	RC	C	[RC]	RC	RC	RC				C						
	Oil	RC	C	[RC]	RC	RC	RC	[C]					C				
	H.P	RC	C	[RC]		RC	RC					C					
NV	4																
	Electric	RC	C	RC	RC	RC	RC	C		RC	C						
	Gas	RC	C	RC	RC	RC	RC				C						
	Oil	RC	C	RC	RC	RC	RC	C					C				
	H.P	RC	C	RC		RC	RC					C					
NV	5																
	Electric	RC	C	RC	RC	RC	RC	C		RC	C						
	Gas	RC	C	RC	RC	RC	RC	C			C						
	Oil	RC	C	RC	RC	RC	RC	C					C				
	H.P	RC	C	RC		RC	RC	C				C					
NV	6																
	Electric	RC	C	RC	RC	RC	RC	C		RC	C						
	Gas	RC	C	RC	RC	RC	RC	C			C						
	Oil	RC	C	RC	RC	RC	RC	C			C		C				
	H.P	RC	C	RC		RC	RC	C			C	C					
NV	7																
	Electric	RC	C	RC	RC	RC	RC	C		RC	C						
	Gas	RC	C	RC	RC	RC	RC	C			C						
	Oil	RC	C	RC	RC	RC	RC	C			C		C				
	H.P	RC	C	RC		RC	RC	C			C	C					
NV	8																
	Electric	RC	C	RC	RC	RC	RC	C		RC						C	
	Gas	RC	C	RC	RC	RC	RC	C			C		C				
	Oil	RC	C	RC	RC	RC	RC	C			C	C					
	H.P	RC	C	RC		RC	RC	C								C	

NH	7																
	Electric	RC	C	RC	RC	RC	RC	C		RC	C					C	
	Gas	RC	C	RC	R	RC	RC	C			C		C				
	Oil	RC	C	RC	RC	RC	RC	C			C	C					
	H.P	RC	C	RC		RC	RC	C								C	
NH	8																
	Electric	RC	C	RC	RC	RC	RC	C		RC						C	[x]*
	Gas	RC	C	RC	RC	RC	RC	C			C		C				
	Oil	RC	C	RC	RC	RC	RC	C			C	C					
	H.P	RC	C	RC		RC	RC	C			C					C	[x]*
NJ	5																
	Electric	RC	C	RC	RC	RC	RC	C		RC	C			C		C	
	Gas	RC	C	RC	R	RC	RC	C			C		C				
	Oil	RC	C	RC	RC	RC	RC	C			C	C					
	H.P	RC	C	RC		RC	RC	C								C	
NJ	6																
	Electric	RC	C	RC	RC	RC	RC	C		RC	C			C		C	
	Gas	RC	C	RC	R	RC	RC	C			C		C				
	Oil	RC	C	RC	RC	RC	RC	C			C	C					
	H.P	RC	C	RC		RC	RC	C								C	
NM	3																
	Electric	RC	C	RC	RC	RC	RC	C		RC	C			C	C		[x]*
	Gas	RC	C	[RC]	RC	RC	RC	[C]					C				
	Oil	RC	C	[RC]	RC	RC	RC	[C]				C					
	H.P	RC	C	[RC]		RC	RC	[C]									[x]*
NM	4																
	Electric	RC	C	RC	RC	RC	RC	C		RC	C			C	C		[x]*
	Gas	RC	C	RC	RC	RC	RC	C			C		C				
	Oil	RC	C	RC	RC	RC	RC	C				C					
	H.P	RC	C	RC		RC	RC	C									[x]*
NM	5																
	Electric	RC	C	RC	RC	RC	RC	C		RC	C			C	C	C	[x]*
	Gas	RC	C	RC	RC	RC	RC	C			C		C				
	Oil	RC	C	RC	RC	RC	RC	C				C					
	H.P	RC	C	RC		RC	RC	C								C	[x]*
NM	6																
	Electric	RC	C	RC	RC	RC	RC	C		RC	C			C	C		[xy]*
	Gas	RC	C	RC	RC	RC	RC	C			C		C				
	Oil	RC	C	RC	RC	RC	RC	C			C	C					
	H.P	RC	C	RC		RC	RC	C									[xy]*
NM	7																
	Electric	RC	C	RC	RC	RC	RC	C		RC	C			C	C		
	Gas	RC	C	RC	RC	RC	HC	C			C		C				
	Oil	RC	C	RC	RC	RC	RC	C			C	C					
	H.P	RC	C	RC		RC	RC	C									
NM	8																
	Electric	RC	C	RC	RC	RC	RC	C		RC	C				C	C	[x]*
	Gas	RC	C	RC	R	RC	RC				C		C				
	Oil	RC	C	RC	RC	RC	RC	C			C	C					
	H.P	RC	C	RC		RC	RC	C								C	[x]*

TABLE 2—Continued

State	HUD/MPS region fuel	Insulation						Storm or thermal windows	Storm or thermal doors	Heat reflective and absorbing window materials	Replacement heating system	Replacement oil burner	Vent damper	Replacement central air conditioner	Solar domestic water heater	Replacement solar pool heater	Wind energy
		Ceiling	Wall	Floor	Water heater	Duct	Pipe										
NY	6																
	Electric	RC	C	RC	RC	RC	RC	C		RC	C				C	C	[x]*
	Gas	RC	C	RC	RC	RC	RC	C			C		C				
	Oil	RC	C	RC	RC	RC	RC	C			C	C					
	H.P	RC	C	RC		RC	RC	C								C	[x]*
NY	7																
	Electric	RC	C	RC	RC	RC	RC	C		RC	C				C	C	[xy]*
	Gas	RC	C	RC	RC	RC	RC	C			C		C				
	Oil	RC	C	RC	RC	RC	RC	C			C	C					
	H.P	RC	C	RC		RC	RC	C								C	[xy]*
NY	8																
	Electric	RC	C	RC	RC	RC	RC	C	C	RC	C				C	C	[xy]*
	Gas	RC	C	RC	R	RC	RC	C			C		C				
	Oil	RC	C	RC	R	RC	RC	C			C	C					
	H.P.	RC	C	RC		RC	RC	C								C	[xy]*
NC	2																
	Electric	RC	C	[RC]	RC	RC	RC	C		RC				C		C	
	Gas	RC		[RC]	RC	R	RC						C				
	Oil	RC	C	[RC]	RC	RC	RC	[C]				C					
	H.P.	RC		[R]		R	R									C	
NC	3																
	Electric	RC	C	RC	RC	RC	RC	C		RC	C			C		C	
	Gas	RC	C	[RC]	RC	RC	RC				C		C				
	Oil	RC	C	[RC]	RC	RC	RC	[C]				C					
	H.P.	RC	C	[RC]		RC	RC									C	
NC	4																
	Electric	RC	C	RC	RC	RC	RC	C		RC	C					C	
	Gas	RC	C	RC	RC	RC	RC				C		C				
	Oil	RC	C	RC	RC	RC	RC	C				C					
	H.P.	RC	C	RC		RC	RC									C	
NC	5																
	Electric	RC	C	RC	RC	RC	RC	C		RC	C						
	Gas	RC	C	RC	RC	RC	RC				C		C				
	Oil	RC	C	RC	RC	RC	RC	C			C	C					
	H.P.	RC	C	RC		RC	RC										
ND	8																
	Electric	RC	C	RC	RC	RC	RC	C		RC	C						
	Gas	RC	C	RC	RC	RC	RC	C					C				

	Oil	RC	C	RC	RC	RC	RC	C			C	C					
	H.P.	RC	C	RC		RC	RC	C									
OH	5																
	Electric	RC	C	RC	RC	RC	RC	C		RC	C					C	
	Gas	RC	C	RC	RC	RC	RC				C		C				
	Oil	RC	C	RC	RC	RC	RC	C			C	C					
	H.P.	RC	C	RC		RC	RC	C								C	
OH	6																
	Electric	RC	C	RC	RC	RC	RC	C		RC	C					C	
	Gas	RC	C	RC	RC	RC	RC				C		C				
	Oil	RC	C	RC	RC	RC	RC	C			C	C					
	H.P.	RC	C	RC		RC	RC	C								C	
OH	7																
	Electric	RC	C	RC	RC	RC	RC	C		RC	C					C	
	Gas	RC	C	RC	RC	RC	RC	C			C		C				
	Oil	RC	C	RC	RC	RC	RC	C			C	C					
	H.P.	RC	C	RC		RC	RC	C								C	
OK	3																
	Electric	RC	C	RC	RC	RC	RC	C		RC	C			C			[x]*
	Gas	RC	C	[RC]	RC	RC	RC	[C]					C				
	Oil	RC	C	[RC]	RC	RC	RC	[C]				C					
	H.P.	RC	C	[RC]		RC	RC	[C]									[x]*
OK	4																
	Electric	RC	C	RC	RC	RC	RC	C		RC	C			C			[xy]*
	Gas	RC	C	RC	RC	RC	RC	C					C				
	Oil	RC	C	RC	RC	RC	RC	C				C					
	H.P.	RC	C	RC		RC	RC	C									[xy]*
OK	5																
	Electric	RC	C	RC	RC	RC	RC	C		RC	C			C	C		[xy]*
	Gas	RC	C	RC	RC	RC	RC	C			C		C				
	Oil	RC	C	RC	RC	RC	RC	C			C	C					
	H.P.	RC	C	RC		RC	RC	C									[xy]*
OK	6																
	Electric	RC	C	RC	RC	RC	RC	C		RC	C			C	C	C	[xy]*
	Gas	RC	C	RC	RC	RC	RC	C			C		C				
	Oil	RC	C	RC	RC	RC	RC	C			C	C				C	
	H.P.	RC	C	RC		RC	RC	C								C	[xy]*
OR	4																
	Electric	RC	C	RC	RC	RC	RC			RC							
	Gas	RC	C	RC	RC	RC	RC	C			C		C				
	Oil	RC	C	RC	RC	RC	RC	C				C					
	H.P.	RC		RC		RC	RC										
OR	5																
	Electric	RC	C	RC	RC	RC	RC			RC							
	Gas	RC	C	RC	RC	RC	RC	C			C		C				
	Oil	RC	C	RC	RC	RC	RC	C			C	C					
	H.P.	RC		RC		RC	RC										
OR	6																
	Electric	RC	C	RC	RC	RC	RC			RC							
	Gas	RC	C	RC	RC	RC	RC	C			C		C				

TABLE 2—Continued

State	HUD/MPS region fuel	Insulation						Storm or thermal windows	Storm or thermal doors	Heat reflective and absorbing window materials	Replacement heating system	Replacement oil burner	Vent damper	Replacement central air conditioner	Solar domestic water heater	Replacement solar pool heater	Wind energy
		Ceiling	Wall	Floor	Water heater	Duct	Pipe										
	Oil	RC	C	RC	RC	RC	RC	C			C	C					
	H.P.	RC	C	RC		RC	RC										
OR	7																
	Electric	RC	C	RC	RC	RC	RC			RC							
	Gas	RC	C	RC	RC	RC	RC	C			C		C				
	Oil	RC	C	RC	RC	RC	RC	C			C	C					
	H.P.	RC	C	RC		RC	RC										
OR	6																
	Electric	RC	C	RC	RC	RC	RC	C		RC							
	Gas	RC	C	RC	RC	RC	RC	C			C		C				
	Oil	RC	C	RC	RC	RC	RC	C			C	C					
	H.P.	RC	C	RC		RC	RC										
PA	5																
	Electric	RC	C	RC	RC	RC	RC	C		RC	C					C	
	Gas	RC	C	RC	R	RC	RC				C		C				
	Oil	RC	C	RC	RC	RC	RC	C			C	C					
	H.P.	RC	C	RC		RC	RC	C								C	
PA	6																
	Electric	RC	C	RC	RC	RC	RC	C		RC	C					C	
	Gas	RC	C	RC	RC	RC	RC				C		C				
	Oil	RC	C	RC	RC	RC	RC	C			C	C					
	H.P.	RC	C	RC		RC	RC	C								C	
PA	7																
	Electric	RC	C	RC	RC	RC	RC	C		RC	C						
	Gas	RC	C	RC	R	RC	RC				C		C				
	Oil	RC	C	RC	R	RC	RC	C			C	C					
	H.P.	RC	C	RC		RC	RC	C									
PA	8																
	Electric	RC	C	RC	RC	RC	RC	C		RC							
	Gas	RC	C	RC	R	RC	RC	C			C		C				
	Oil	RC	C	RC	R	RC	RC	C			C	C					
	H.P.	RC	C	RC		RC	RC	C									
RI	6																
	Electric	RC	C	RC	RC	RC	RC	C	C	RC	C					C	[illegible]
	Gas	RC	C	RC	RC	RC	RC	C			C		C				
	Oil	RC	C	RC	RC	RC	RC	C			C	C					
	H.P.	RC	C	RC		RC	RC	C								C	[illegible]
SC	8																

	Electric	RC	C	[RC]	RC	RC	RC	C		RC				C		C
	Gas	RC		[RC]	RC	R	RC						C			
	Oil	RC	C	[RC]	RC	RC	RC	[C]				C				
	H.P.	RC		[R]		R	R									C
SC	3															
	Electric	RC	C	RC	RC	RC	RC	C		RC	C			C		C
	Gas	RC	C	[RC]	RC	RC	RC				C		C			
	Oil	RC	C	[RC]	RC	RC	RC	[C]				C				C
	H.P.	RC	C	[RC]		RC	RC									C
SC	4															
	Electric	RC	C	RC	RC	RC	RC	C		RC	C					C
	Gas	RC	C	RC	RC	RC	RC				C		C			
	Oil	RC	C	RC	RC	RC	RC	C				C				
	H.P.	RC	C	RC		RC	RC									C
SD	7															
	Electric	RC	C	RC	RC	RC	RC	C		RC	C					C
	Gas	RC	C	RC	RC	RC	RC	C			C		C			
	Oil	RC	C	RC	RC	RC	RC	C			C	C				
	H.P.	RC	C	RC		RC	RC	C								C
SD	8															
	Electric	HC	C	RC	RC	RC	RC	C		RC						C
	Gas	RC	C	RC	RC	RC	RC	C			C		C			
	Oil	RC	C	RC	RC	RC	RC	C			C	C				
	H.P.	RC	C	RC		RC	RC	C								C
TN	3															
	Electric	RC	C	RC	RC	RC	RC	C		RC	C					
	Gas	RC		[RC]	RC	RC	RC						C			
	Oil	RC	C	[RC]	RC	RC	RC	[C]				C				
	H.P.	RC	C	[RC]		RC	RC									
TN	4															
	Electric	RC	C	RC	RC	RC	RC	C		RC	C					
	Gas	RC	C	RC	RC	RC	RC						C			
	Oil	RC	C	RC	RC	RC	RC	C				C				
	H.P.	RC	C	RC		RC	RC									
TN	5															
	Electric	RC	C	RC	RC	RC	RC	C		RC	C					
	Gas	RC		RC	RC	RC	RC						C			
	Oil	RC	C	RC	RC	RC	RC	C			C	C				
	H.P.	RC	C	RC		RC	RC									
TX	1															
	Electric	RC	C	[R]	RC	R	R	[C]		RC				C		
	Gas	RC	C		RC	R	R	[C]								
	Oil	RC	C	[R]	RC	R	R	[C]								
	H.P.	RC	C			R	R	[C]								
TX	2															
	Electric	RC	C	[RC]	RC	RC	RC	C		RC	C			C		
	Gas	RC	C	[RC]	RC	RC	RC	[C]					C			
	Oil	RC	C	[RC]	RC	RC	RC	[C]				C				
	H.P.	RC	C	[RC]		RC	RC	[C]								
TX	3															

TABLE 2—Continued

State	HUD/MPS region fuel	Insulation						Storm or thermal windows	Storm or thermal doors	Heat reflective and absorbing window materials	Replacement heating system	Replacement oil burner	Vent damper	Replacement central air conditioner	Solar domestic water heater	Replacement solar pool heater	Wind energy
		Ceiling	Wall	Floor	Water heater	Duct	Pipe										
	Electric	RC	C	RC	RC	RC	RC	C		RC	C			C			
	Gas	RC	C	[RC]	RC	RC	RC	[C]			C		C				
	Oil	RC	C	[RC]	RC	RC	RC	[C]				C					
	H.P.	RC	C	[RC]		RC	RC	[C]									
TX	4																
	Electric	RC	C	RC	RC	RC	RC	C		RC	C			C		C	
	Gas	RC	C	RC	RC	RC	RC	C			C		C				
	Oil	RC	C	RC	RC	RC	RC	C				C				C	
	H.P.	RC	C	RC		RC	RC	C								C	
TX	5																
	Electric	RC	C	RC	RC	RC	RC	C		RC	C			C		C	
	Gas	RC	C	RC	RC	RC	RC	C			C		C				
	Oil	RC	C	RC	RC	RC	RC	C			C	C				C	
	H.P.	RC	C	RC		RC	RC	C								C	
UT	5																
	Electric	RC	C	RC	RC	RC	RC	C		RC	C			C			
	Gas	RC	C	RC	RC	RC	RC				C		C				
	Oil	RC	C	RC	RC	RC	RC	C			C	C					
	H.P.	RC	C	RC		RC	RC	C									
UT	6																
	Electric	RC	C	RC	RC	RC	RC	C		RC	C					C	
	Gas	RC	C	RC	R	RC	RC				C		C				
	Oil	RC	C	RC	RC	RC	RC	C			C	C					
	H.P.	RC	C	RC		RC	RC	C								C	
UT	7																
	Electric	RC	C	RC	RC	RC	RC	C		RC	C				C		
	Gas	RC	C	RC	RC	RC	RC				C		C				
	Oil	RC	C	RC	RC	RC	RC	C			C	C					
	H.P.	RC	C	RC		RC	RC	C									
UT	8																
	Electric	RC	C	RC	RC	RC	RC	C		RC					C		
	Gas	RC	C	RC	RC	RC	RC	C			C		C				
	Oil	RC	C	RC	RC	RC	RC	C			C	C					
	H.P.	RC	C	RC		RC	RC	C									
VT	7																
	Electric	RC	C	RC	RC	RC	RC	C		RC	C						[x][3]
	Gas	RC	C	RC	R	RC	RC	C			C		C				

	H.P.	RC	C	RC		RC	RC	C									[x]*
VT	8									RC						C	[x]*
	Electric	RC	C	RC	RC	RC	RC	C			C		C				
	Gas	RC	C	RC	RC	RC	RC	C			C	C					
	Oil	RC	C	RC	RC	RC	RC	C								C	[x]*
	H.P.	RC	C	RC		RC	RC	C									
VA	3									RC	C			C		C	
	Electric	RC	C	RC	RC	RC	RC	C			C		C				
	Gas	RC	C	[RC]	RC	RC	RC	[C]				C					
	Oil	RC	C	[RC]	RC	RC	RC	[C]								C	
	H.P.	RC	C	[RC]		RC	RC	[C]									
VA	4									RC	C					C	
	Electric	RC	C	RC	RC	RC	RC	C			C		C				
	Gas	RC	C	RC	RC	RC	RC					C					
	Oil	RC	C	RC	RC	RC	RC	C								C	
	H.P.	RC	C	RC		RC	RC	C									
VA	5									RC	C					C	
	Electric	RC	C	RC	RC	RC	RC	C			C		C				
	Gas	RC	C	RC	RC	RC	RC	C			C	C					
	Oil	RC	C	RC	RC	RC	RC	C								C	
	H.P.	RC	C	RC		RC	RC	C									
VA	6									RC	C					C	
	Electric	RC	C	RC	RC	RC	RC	C			C		C				
	Gas	RC	C	RC	RC	RC	RC	C			C	C					
	Oil	RC	C	RC	RC	RC	RC	C								C	
	H.P.	RC	C	RC		RC	RC	C									
WA	6									RC							
	Electric	RC		RC		RC	RC				C		C				
	Gas	RC	C	RC	R	RC	RC	C			C	C					
	Oil	RC	C	RC	R	RC	RC	C									
	H.P.	R		RC		RC	RC										
WA	7									RC							
	Electric	RC		RC	R	RC	RC				C		C				
	Gas	RC	C	RC	RC	RC	RC	C			C	C					
	Oil	RC	C	RC	RC	RC	RC	C									
	H.P.	RC		RC		RC	RC										
WA	8									RC							
	Electric	RC	C	RC	R	RC	RC				C		C				
	Gas	RC	C	RC	RC	RC	RC	C			C	C					
	Oil	RC	C	RC	RC	RC	RC	C									
	H.P.	RC	C	RC		RC	RC										
WV	5									RC	C						
	Electric	RC	C	RC	RC	RC	RC				C		C				
	Gas	RC	C	RC	RC	RC	RC	C			C	C					
	Oil	RC	C	RC	RC	RC	RC	C									
	H.P.	RC	C	RC		RC	RC										
WV	6									RC	C						
	Electric	RC	C	RC	RC	RC	RC	C			C		C				
	Gas	RC	C	RC	RC	RC	RC				C	C					
	Oil	RC	C	RC	RC	RC	RC	C									

TABLE 2—Continued

State	HUD/MPS region fuel	Insulation						Storm or thermal windows	Storm or thermal doors	Heat reflective and absorbing window materials	Replacement heating system	Replacement oil burner	Vent damper	Replacement central air conditioner	Solar domestic water heater	Replacement solar pool heater	Wind energy
		Ceiling	Wall	Floor	Water heater	Duct	Pipe										
	H.P.	RC	C	RC		RC	RC	C									
WI	7																
	Electric	RC	C	RC	RC	RC	RC	C		RC	C						
	Gas	RC	C	RC	RC	RC	RC	C			C		C				
	Oil	RC	C	RC	RC	RC	RC	C			C	C					
	H.P.	RC	C	RC		RC	RC	C									
WI	8																
	Electric	RC	C	RC	RC	RC	RC	C		RC							
	Gas	RC	C	RC	RC	RC	RC	C			C		C				
	Oil	RC	C	RC	RC	RC	RC	C			C	C					
	H.P.	RC	C	RC		RC	RC	C									
WY	7																
	Electric	RC	C	RC	RC	RC	RC	C		RC	C						
	Gas	RC	C	RC	RC	RC	RC				C		C				
	Oil	RC	C	RC	RC	RC	RC	C			C	C					
	H.P.	RC	C	RC		RC	RC	C									
WY	8																
	Electric	RC	C	RC	RC	RC	RC	C		RC							
	Gas	RC	C	RC	R	RC	RC				C		C				
	Oil	RC	C	RC	RC	RC	RC	C			C	C					
	H.P.	RC	C	RC		RC	RC	C									
PR	1																
	Electric	RC	C	[RC]	RC	RC	RC	[C]	[C]	RC				C	C		
	Gas	RC	C	[R]	RC	R	R	[C]	[C]								
	Oil	RC	C	[R]	RC	R	R	[C]	[C]								
	H.P.	RC	C	[R]		R	R	[C]	[C[								

State	HUD/Region	Fuel category	Direct gain	Indirect gain	Solaria sunspace	Window heat loss retardants	Window heat gain retardants [1]
Alabama	2	Electric				R	R, C.
		Gas					
		Oil				R	
		H.P.					
	3	Electric			R	R	R, C.

		Gas			R	R	
		Oil					
Alaska	8	H.P.				R, C	R, C.
		Electric				R	
		Gas				R, C	
		Oil				R, C	
Arizona	1	H.P.			R		R, C.
		Electric			R		
		Gas			R		
		Oil					
	2	H.P.	R	R	R, C	R	R, C.
		Electric	R		R, C		
		Gas	R		R, C		
		Oil			R		
	3	H.P.	R, C	R, C	R, C	R, C	R, C.
		Electric	R	R	R, C	R	
		Gas	R	R	R, C	R	
		Oil	R	R	R, C	R	
	4	H.P.	R	R, C	R, C	R, C	R, C.
		Electric	R	R	R, C	R	
		Gas	R	R	R, C	R	
		Oil	R	R	R, C	R	
	5	H.P.	R	R	R, C	R, C	R, C.
		Electric		R	R, C	R	
		Gas	R	R	R, C	R	
		Oil	R	R	R, C	R	
	6	H.P.	R, C	R	R, C	R, C	R, C.
		Electric	R	R	R, C	R	
		Gas	R	R	R, C	R	
		Oil	R	R	R, C	R, C	
	7	H.P.	R	R	R, C	R, C	R, C.
		Electric			R, C	R	
		Gas		R	R, C	R	
		Oil	R	R	R, C	R, C	
Arkansas	3	H.P.	R		R	R	R, C.
		Electric					
		Gas			R	R	
		Oil				R	
	4	H.P.			R	R, C	R, C
		Electric					
		Gas			R	R	
		Oil			R	R	
California	2	H.P	R	R	R, C	R	R, C
		Electric			R	R	
		Gas		R	R	R	
		Oil			R	R	
	3	H.P	R, C	R	R, C	R, C	R, C
		Electric	R		R	R	
		Gas	R	R	R, C	R, C	
		Oil					

State	HUD/Region	Fuel category	Direct gain	Indirect gain	Solaris sunspace	Window heat loss retardants	Window heat gain retardants [1]
	4	H.P	R		R	R	R, C.
		Electric	R, C	R	R, C	R, C	
		Gas	R	R	R	R	
		Oil	R, C	R	R, C	R, C	
	5	H.P	R	R	R	R, C	R, C.
		Electric	R, C	R, C	R, C	R, C	
		Gas	R	R	R	R	
		Oil	R, C	R	R, C	R, C	
	6	H.P	R, C	R	R, C	R, C	R, C.
		Electric	R, C	R, C	R, C	R, C	
		Gas	R	R	R	R	
		Oil	R	R	R, C	R, C	
	7	H.P	R	R	R, C	R, C	R, C.
		Electric	R, C	R, C	R, C	R, C	
		Gas	R	R	R	R, C	
		Oil	R, C	R	R, C	R, C	
	8	H.P	R	R	R, C	R, C	R, C.
		Electric	R	R	R, C	R, C	
		Gas	R		R	R, C	
		Oil	R	R	R, C	R, C	
Colorado	6	H.P	R	R	R, C	R, C	R, C.
		Electric	R	R	R, C	R, C	
		Gas			R	R	
		Oil	R	R	R, C	R	
	7	H.P	R	R	R, C	R	R, C.
		Electric	R	R	R, C	R, C	
		Gas			R	R	
		Oil	R	R	R, C	R, C	
	8	H.P	R	R	R, C	R	R, C.
		Electric	R	R	R, C	R, C	
		Gas			R	R	
		Oil			R, C	R, C	
Connecticut	6	H.P	R	R	R, C	R, C	R, C.
		Electric			R, C	R, C	
		Gas				R	
		Oil			R	R, C	
Delaware	4	H.P.			R	R, C	R, C.
		Electric			R	R, C	
		Gas				R	
		Oil			R	R	
District of Columbia	4	H.P.				R	R, C.
		Electric			R	R	
		Gas				R	
		Oil			R	R	
Florida	1	H.P.				R	R, C
		Electric				R	

		Gas					
		Oil					
		H.P.					
	2	Electric			R	R	R, C.
		Gas					
		Oil			R		
		H.P.					
Georgia	2	Electric					R, C.
		Gas					
		Oil					
		H.P.					
	3	Electric			R	R	R, C.
		Gas					
		Oil			R	R	
		H.P.					
	4	Electric			R	R	R C.
		Gas					
		Oil			R	R	
		H.P.				R	
Hawaii	1	Electric					R, C.
		Gas					
		Oil					
		H.P.					
Idaho	7	Electric				R	R, C.
		Gas			R	R	
		Oil			R	R, C	
		H.P.				R	
	8	Electric				R	R, C.
		Gas			R	R	
		Oil			R	R	
		H.P.			R		
Illinois	4	Electric			R	R, C	R, C.
		Gas				R	
		Oil			R	R	
		H.P.				R	
	5	Electric			R	R, C	R, C.
		Gas				R	
		Oil			R	R	
		H.P.			R	R	
	6	Electric			R	R, C	R, C.
		Gas				R	
		Oil			R	R	
		H.P.				R	
	7	Electric			R	R, C	R, C.
		Gas				R	
		Oil			R	R, C	
		H.P.			R	R	
Indiana	4	Electric			R	R	RC
		Gas					
		Oil			R	R	

State	HUD/Region	Fuel category	Direct gain	Indirect gain	Solaria sunspace	Window heat loss retardants	Window heat gain retardants [1]
		H.P.			R	R	
	5	Electric			R, C	R	R, C.
		Gas			R	R	
		Oil			R, C	R	
		H.P.			R	R	
	6	Electric			R, C	R	R, C.
		Gas				R	
		Oil			R, C	R	
		H.P.			R	R	
	7	Electric			R, C	R, C	R, C.
		Gas			R	R	
		Oil			R, C	R, C	
		H.P.			R	R	
Iowa	6	Electric			R	R, C	R, C.
		Gas				R	
		Oil			R	R	
		H.P.			R	R	
	7	Electric			R	R, C	R, C.
		Gas				R	
		Oil			R	R	
		H.P.			R	R	
	8	Electric			R	R, C	R, C.
		Gas				R	
		Oil			R	R, C	
		H.P.			R	R, C	
Kansas	4	Electric	R		R, C	R, C	R, C.
		Gas					
		Oil			R	R	
		H.P.			R	R	
	5	Electric	R	R	R, C	R, C	R, C.
		Gas					
		Oil			R	R	
		H.P.			R	R	
	6	Electric	R	R	R, C	R, C	R, C.
		Gas					
		Oil	R	R	R	R	
		H.P.			R	R	
	7	Electric	R	R	R, C	R, C	R, C.
		Gas					
		Oil	R	R	R, C	R	
		H.P.	R	R	R, C	R	
Kentucky	4	Electric				R	R, C.
		Gas					
		Oil			R	R	
		H.P.				R	
	6	Electric			R, C	R	R, C.

		Gas				R, C	R	
		Oil				R	R	
		H.P.					R	R, C.
	6	Electric						
		Gas				R	R	
		Oil					R	
		H.P.				R	R	R, C.
Louisiana	2	Electric						
		Gas						
		Oil						
		H.P.				R	R	R, C.
	3	Electric						
		Gas				R	R	
		Oil				R	R	
		H.P.				R, C	R, C	R, C.
Maine	8	Electric					R	
		Gas				F	R, C	
		Oil				R	R, C	
		H.P.				P	R	R, C.
Maryland	4	Electric					R	
		Gas				R	R	
		Oil					R	
		H.P.				R	R, C	R, C.
	5	Electric					R	
		Gas				R	R	
		Oil					R	
		H.P			R	R	R, C	R, C.
	6	Electric					R	
		Gas			R	R	R	
		Oil					R	
		H.P				R, C	R, C	R, C.
Massachusetts	6	Electric				R	R	
		Gas				R, C	R	
		Oil				R, C	R, C	
		H.P				R, C	R, C	R, C.
	7	Electric				R	R	
		Gas				R, C	R, C	
		Oil				R, C	R, C	
		H.P				R, C	R, C	R, C.
Michigan	7	Electric				R	R	
		Gas				R, C	R, C	
		Oil				R	R	
		H.P				R, C	R, C	R, C.
	8	Electric					R	
		Gas				R	R, C	
		Oil				R	R, C	
		H.P				R, C	R, C	R, C.
Minnesota	8	Electric				R	R	
		Gas				R, C	R, C	
		Oil						

State	HUD/Region	Fuel category	Direct gain	Indirect gain	Solaris sunspace	Window heat loss retardants	Window heat gain retardants[1]
		H.P			R, C	R, C	
Mississippi	2	Electric					R, C.
		Gas					
		Oil					
		H.P					
	3	Electric			R	R	R, C.
		Gas					
		Oil			R	R	
		H.P					
Missouri	4	Electric			R	R, C	R, C.
		Gas				R	
		Oil			R	R	
		H.P				R	
	5	Electric			R	R, C	R, C.
		Gas				R	
		Oil			R	R	
		H.P			R	R	
	6	Electric			R	R, C	R, C.
		Gas				R	
		Oil			R	R	
		H.P.			R	R	
Montana	6	Electric			R	R	R, C.
		Gas				R	
		Oil			R	R, C	
		H.P.			R	R	
Nebraska	6	Electric			R	R, C	R, C.
		Gas					
		Oil			R	R	
		H.P.				R	
	7	Electric			R	R, C	R, C.
		Gas				R	
		Oil			R	R	
		H.P.			R	R	
	8	Electric			R	R, C	R, C.
		Gas				R	
		Oil			R	R, C	
		H.P.			R	R, C	
Nevada	2	Electric			R	R	R, C.
		Gas					
		Oil			R		
		H.P.					
	3	Electric	R		R, C	R	R, C.
		Gas			R	R	
		Oil			R	R	
		H.P.			R	R	

		Gas				R	R
		Oil				R	R
		H.P.				R	R
	5	Electric				R, C	R	R, C.
		Gas				R	R	
		Oil				R	R	
		H.P.				R	R	
	6	Electric				R, C	R, C	R, C.
		Gas				R	R	
		Oil				R	R	
		H.P.				R	R	
	7	Electric	R	R		R, C	R, C	R, C.
		Gas				R	R	
		Oil				R, C	R	
		H.P.				R	R	
	8	Electric				R, C	R, C	R, C.
		Gas				R	R, C	
		Oil				R	R, C	
		H.P				R	R, C	
New Hampshire	7	Electric				R, C	R, C	R, C.
		Gas					R	
		Oil				R	R, C	
		H.P				R	R, C	
	8	Electric				R, C	R, C	R, C.
		Gas					R	
		Oil				R	R, C	
		H.P				R, C	R, C	
New Jersey	5	Electric				R	R, C	R, C.
		Gas					R	
		Oil				R	R	
		H.P				R	R	
	6	Electric				R, C	R, C	R, C.
		Gas					R	
		Oil				R	R	
		H.P				R	R, C	
New Mexico	3	Electric	R, C	R		R, C	R, C	R, C.
		Gas				R		
		Oil	R	R		R, C	R	
		H.P	R	R		R, C	R	
	4	Electric	R, C	R, C		R, C	R, C	R, C.
		Gas				R	R	
		Oil	R	R		R, C	R	
		H.P	R	R		R, C	R	
	5	Electric	R, C	R		R, C	R, C	R, C.
		Gas				R	R	
		Oil	R	R		R, C	R	
		H.P	R	R		R, C	R, C	
	6	Electric	R, C	R, C		R, C	R, C	R, C.
		Gas				R	R	
		Oil	R	R		R, C	R	

State	HUD/Region	Fuel category	Direct gain	Indirect gain	Solaria sunspace	Window heat loss retardants	Window heat gain retardants[1]
	7	H.P	R	R	R, C	R, C	R, C.
		Electric	R, C	R, C	R, C	R, C	
		Gas			R, C	R	
		Oil	R	R	R, C	R	
	8	H.P	R	R	R, C	R, C	R, C.
		Electric	R	R	R, C	R, C	
		Gas			R	R	
		Oil			R, C	R, C	
New York	6	H.P	R	R	R, C	R, C	R, C.
		Electric	R, C	R	R, C	R, C	
		Gas			R	R	
		Oil	R		R	R	
	7	H.P	R	R	R, C	R, C	R, C.
		Electric	R	R	R, C	R, C	
		Gas			R	R	
		Oil	R		R	R, C	
	8	H.P	R	R	R, C	R,C	R, C.
		Electric	R	R	R, C	R, C	
		Gas			R	R	
		Oil	R		R	R, C	
North Carolina	2	H.P	R	R	R, C	R, C	R, C.
		Electric			R	R	
		Gas					
		Oil			R	R	
	3	H.P.					R, C.
		Electric			R	R	
		Gas			R	R	
		Oil			R	R	
	4	H.P.			R	R	R, C.
		Electric			R, C	R, C	
		Gas			R	R	
		Oil			R, C	R, C	
	5	H.P.			R	R	R, C
		Electric			R, C	R, C	
		Gas			R	R	
		Oil			R, C	R, C	
North Dakota	8	H.P.			R	R	R, C.
		Electric			R	R, C	
		Gas				R	
		Oil			R	R, C	
Ohio	5	H.P			R	R, C	R.
		Electric			R	R, C	
		Gas				R	
		Oil			R	R	
	[illegible]	H.P.				R	R.
		Electric			R	R, C	

							R	
		Gas				R	R	
		Oil				R	R	
		H.P.				R	R, C	R, C.
	7	Electric					R	
		Gas				R	R, C	
		Oil				R	R	
		H.P.			R	R, C	R	R, C.
Oklahoma	3	Electric				R		
		Gas			R	R, C	R	
		Oil				R, C	R	
		H.P				R, C	R, C	R, C.
	4	Electric				R		
		Gas				R, C	R	
		Oil				R, C	R	
		H.P			R	R, C	R, C	R, C.
	5	Electric				R		
		Gas			R	R, C	R	
		Oil				R, C	R	
		H.P			R	R, C	R, C	R, C.
	6	Electric				R		
		Gas			R	R, C	R	
		Oil			R	R, C	R	
		H.P				R	R	R, C.
Oregon	4	Electric				R	R, C	
		Gas				R, C	R, C	
		Oil						
		H.P				R	R	R, C
	5	Electric				R, C	R, C	
		Gas				R, C	R, C	
		Oil					R	
		H.P				R	R	R, C.
	6	Electric				R, C	R, C	
		Gas				R, C	R, C	
		Oil				R	R	
		H.P				R	R	R, C.
	7	Electric				R, C	R, C	
		Gas				R, C	R, C	
		Oil		R		R	R	
		H.P				R	R	R, C.
	8	Electric				R, C	R, C	
		Gas				R, C	R, C	
		Oil				R	R	
		H.P				R	R, C	R, C.
Pennsylvania	5	Electric					R	
		Gas				R	R	
		Oil					R	
		H.P				R	R, C	R, C.
	6	Electric					R	
		Gas				R	R, C	
		Oil						

State	HUD/Region	Fuel category	Direct gain	Indirect gain	Solaria sunspace	Window heat loss retardants	Window heat gain retardants[1]
		H.P				R	
	7	Electric			R	R, C	R, C.
		Gas				R	
		Oil			R	R, C	
		H.P			R	R	
	8	Electric			R	R, C	R, C.
		Gas				R	
		Oil			R	R, C	
		H.P			R	R, C	
Rhode Island	6	Electric			R, C	R, C	R, C.
		Gas				R	
		Oil			R	R, C	
		H.P			R	R, C	
South Carolina	2	Electric					R, C.
		Gas					
		Oil					
		H.P					
	3	Electric			R	R	R, C.
		Gas					
		Oil			R	R	
		H.P					
	4	Electric			R	R	R, C.
		Gas				R	
		Oil			R	R	
		H.P				R	
South Dakota	7	Electric			R	R, C	R, C.
		Gas				R	
		Oil			R	R, C	
		H.P			R	R, C	R, C.
	8	Electric			R	R, C	R, C.
		Gas				R	
		Oil			R	R, C	
		H.P			R	R, C	
Tennessee	3	Electric				R	R, C.
		Gas					
		Oil			R	R	
		H.P					
	4	Electric				R	R, C.
		Gas					
		Oil			R	R	
		H.P					
	5	Electric			R	R	R, C.
		Gas					
		Oil			R	R	
		H.P				R	

		Gas					
		Oil					
		H.P.					
	2	Electric			R	R	R, C.
		Gas					
		Oil			R	R	
		H.P.					
	3	Electric			R, C	R	R, C.
		Gas					
		Oil			R	R	
		H.P.			R	R	
	4	Electric	R	R	R, C	R, C	R, C.
		Gas			R	R	
		Oil			R	R	
		H.P.			R	R	
	5	Electric		R	R, C	R, C	R, C.
		Gas			R	R	
		Oil			R, C	R	
		H.P.			R	R	
Utah	5	Electric	R		R, C	R, C	R, C.
		Gas					
		Oil			R	R	
		H.P.			R	R	
	6	Electric			R, C	R, C	R, C.
		Gas				R	
		Oil			R	R	
		H.P.			R	R	
	7	Electric	R	R	R, C	R, C	R, C.
		Gas			R	R	
		Oil			R, C	R, C	
		H.P.			R, C	R, C	
	8	Electric	R	R	R, C	R, C	R, C.
		Gas			R	R	
		Oil			R, C	R, C	
		H.P.	R	R	R, C	R, C	
Vermont	7	Electric			R, C	R, C	R, C.
		Gas			R	R	
		Oil			R, C	R, C	
		H.P.			R, C	R, C	
	8	Electric			R, C	R, C	R, C.
		Gas			R	R	
		Oil			R, C	R, C	
		H.P.			R, C	R, C	
Virginia	3	Electric			R	R	R, C.
		Gas					
		Oil			R	R	
		H.P.				R	
	4	Electric			R	R	R, C.
		Gas				R	
		Oil			R	R	

State	HUD/Region	Fuel category	Direct gain	Indirect gain	Solaria sunspace	Window heat loss retardants	Window heat gain retardants [1]
	5	H.P.				R	R, C.
		Electric			R	R, C	
		Gas				R	
		Oil			R	R	
	6	H.P.			R	R	R, C.
		Electric			R	R, C	
		Gas				R	
		Oil			R	R	
Washington	6	H.P.				R	R.
		Electric					
		Gas			R	R	
		Oil			R	R	
	7	H.P.					R.
		Electric					
		Gas			R	R	
		Oil			R	R, C	
	8	H.P.					R.
		Electric				R	
		Gas			R	R	
		Oil			R	R, C	
West Virginia	5	H.P.					R, C.
		Electric			R	R	
		Gas					
		Oil			R	R	
	6	H.P.				R	R, C.
		Electric			R	R	
		Gas				R	
		Oil			R	R	
Wisconsin	7	H.P.				R	R, C.
		Electric			R	R, C	
		Gas			R	R	
		Oil			R	R, C	
	8	H.P.			R	R	R, C.
		Electric			R, C	R, C	
		Gas			R	R	
		Oil			R, C	R, C	
Wyoming	7	H.P.			R	R, C	R, C.
		Electric			R	R	
		Gas				R	
		Oil			R	R, C	
	8	H.P.			R	R	R, C.
		Electric			R	R, C	
		Gas				R	
		Oil			R	R, C	
Puerto Rico	1	H.P.			R	R	R, C.
		Electric					

		Gas				
		Oil				
		H.P.				

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[1] This measure is only applicable for homes where the air-conditioning system is powered electrically.

APPENDIX II TO PART 456—PROTOTYPICAL HOUSE ASSUMPTIONS

(a) *Reference House.* (1) The prototypical house, on which the RCS measures table is based, is the ranch style home developed in the National Bureau of Standards document NBSIR 77-1309. This house is based upon a National Association of Home Builders (NAHB) survey of 84,000 homes built by 1,600 builders selected randomly from the builder members of NAHB. The house is typical of ranch style houses built in 1974.

(2) The house has been slightly modified to make it more representative of existing housing stock and to allow for the calculation of all RCS measures. DOE has elected to reduce the insulation levels from the NAHB survey (1974) level of R-19 ceiling and R-11 walls to R-7 insulation in the ceiling and no insulation in the walls as a basis for the measures table. Insulation manufacturers' data on residential retrofit applications for ceiling insulation indicate that the majority of existing attics that have not been reinsulated have an existing R-Value of between R-5 and R-9. The furnace/hot water space has been enlarged to accommodate oil furnaces and storage for solar domestic water heaters. The prototypical house, to provide the basis for audits, is assumed to have the features necessary for the application of renewable energy measures. For example, it was assumed to have a south-facing roof suitable for solar collectors, no obstruction to wind energy systems, and a swimming pool that could use a solar pool heater. It is recognized that many residences do not have these features.

(3) The prototypical house and assumptions were chosen as representative of typical homes in the Nation which could benefit from RCS measures. States are encouraged to review the prototypical house relative to construction practices on the local level. A State may submit an amended RCS measures table based upon modifications to the prototypical house if documentation supports such requests.

(b) *Characteristics of the Prototypical House.* (1) *Infiltration.* The prototypical house is assumed to have deteriorated caulking on window and door frames, no weatherstripping, and no gaskets on electrical outlets. Some minor cracks are assumed to exist in ceiling and floor joints. Some wiring and pipe penetration is assumed through the attic floor.

Existing conditions also include undampered vents, no fireplace, and at least 13 entrances and exits through the home per average day. The infiltration category of the prototypical house is essentially the "poor" category listed in the RCS Model Audit.

(2) *Insulation.* As indicated above, the prototypical house is assumed to have no wall insulation, R-7 ceiling insulation in a vented attic, and no floor or crawl space insulation. The walls with 2 x 4 studs on 16-inch centers have a thermal conductance of 0.21 Btu per hour per square foot per degree Fahrenheit (Btu/h/ft^2/° F). The thermal conductance of the ceiling with joists or truss cords on 24-inch centers is 0.12 Btu/h/ft^2/° F. The thermal conductance of the floor with 2 x 10 floor joists on 24-inch centers and carpeting and vented crawl space is 0.19 Btu/h/ft^2/° F.

(3) *Windows.* All glazing is assumed to be single pane with a thermal conductance of 1.13 Btu/h/ft^2/° F.

(4) *Water Heater.* The water heater is assumed to be more than 3 years old and is in conditioned space with adequate clearance for an insulation jacket.

(5) *Space Heating and Cooling.* Primary space conditioning equipment for the prototypical home includes one of the following: electric resistance furnace, electric resistance baseboard, electric resistance radiant ceiling or wall panels, electric heat pump, electric boiler, natural gas-fired boiler, gas forced air, or oil-fired furnace. An electric drive central air-conditioner is assumed. Industry accepted seasonal efficiencies for existing systems more than 5 years old, and new commercially available systems are used in the calculations. In the prototypical house, combustion air is taken from conditioned space, if required. Oil burners are not retention or wet base types. Natural gas pilot lights are assumed to be on for the heating season. All existing systems in the reference house are more than 5 years old.

(6) *Distribution Systems.* Distribution ducting and hydronic pipe are assumed to be in unconditioned areas and are uninsulated.

(7) *Heating and Cooling System Controls.* The prototypical house is assumed not to have a clock thermostat. It is also assumed that there is no manual nighttime temperature setback.

(8) *Heat Reflecting and Heat Absorbing Window and Door Material.* The prototypical house has 127 sq. ft. of unshaded windows which face east and west. For purposes of calculation, the house was oriented so that the ends of the house which contained no glazing face north and south.

(9) *Solar Domestic Hot Water Systems.* It is assumed that 80 gallons of hot water are used per day by a family of four (ASHRAE Systems Handbooks, 1980). The hip roof is not shaded and has an adequate south-facing area for collectors.

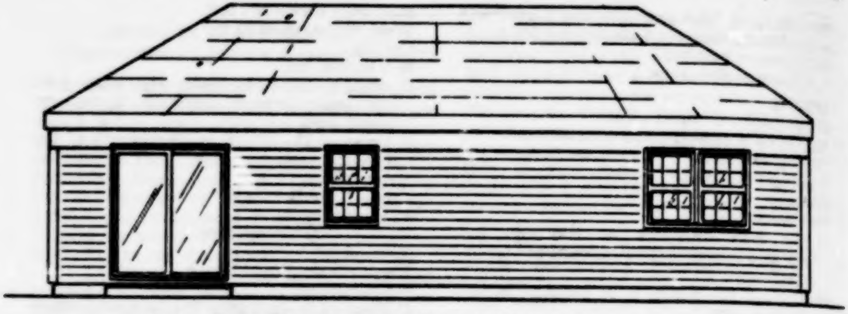
(10) *Replacement Solar Pool Heaters.* The 450 sq. ft. swimming pool is assumed to have a cover that is put in place in nonuse hours.

(11) *Wind Energy Systems.* There is no major obstruction to wind. The size of the wind generator is 2 kW, and all energy gen-

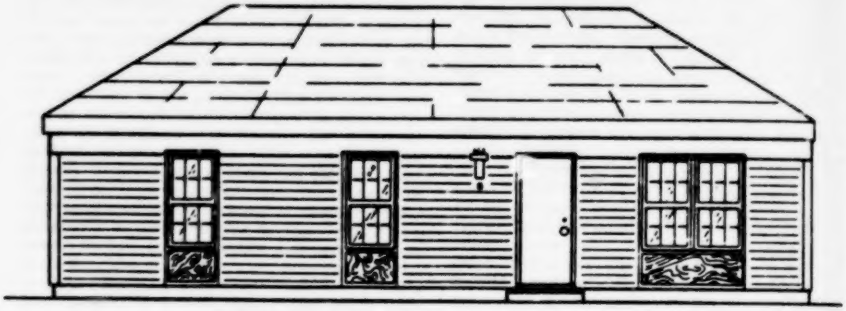
erated is used. The analysis was performed for residences that used electricity for heating and water heating.

(c) *Thermal Envelope.*

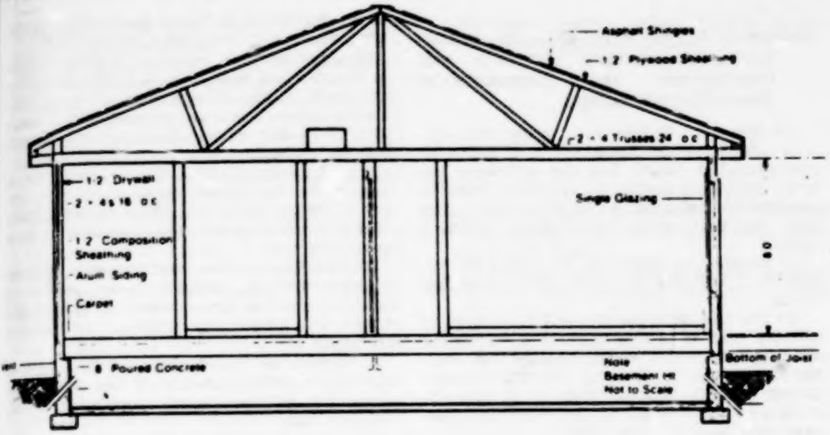
—Glazing
Single panel U-Value=1.13
East area + sliding glass door=72 ft^2
West area=55 ft^2
Total area=127 ft^2
—Walls
No insulation
U wall=0.24—excludes the stud cross section and represents 75 percent of the exposed area
U studs=0.13—which is 25 percent of the exposed area
U overall=0.21—which is the weighted value of the U of the wall and the U of the stud cross section
South wall area=224 ft^2
North wall area=224 ft^2
East wall area=264 ft^2
West wall area=260 ft^2
—Ceiling
R-7 insulation
U ceiling=0.115—excludes the truss cord and represents 90 percent of the exposed area
U truss=0.17—which is 10 percent of the exposed area
U overall=0.12
Area=1,176 ft^2
—Front Entry Door
U=0.47 (hardwood door)
Area=21 ft^2
—Floor Above Crawl Space
No insulation
U floor=0.2—excludes the joist and represents 90 percent of the exposed area
U joist=0.09—which is 10 percent of the exposed area
U overall=0.19
Area=1,176 ft^2



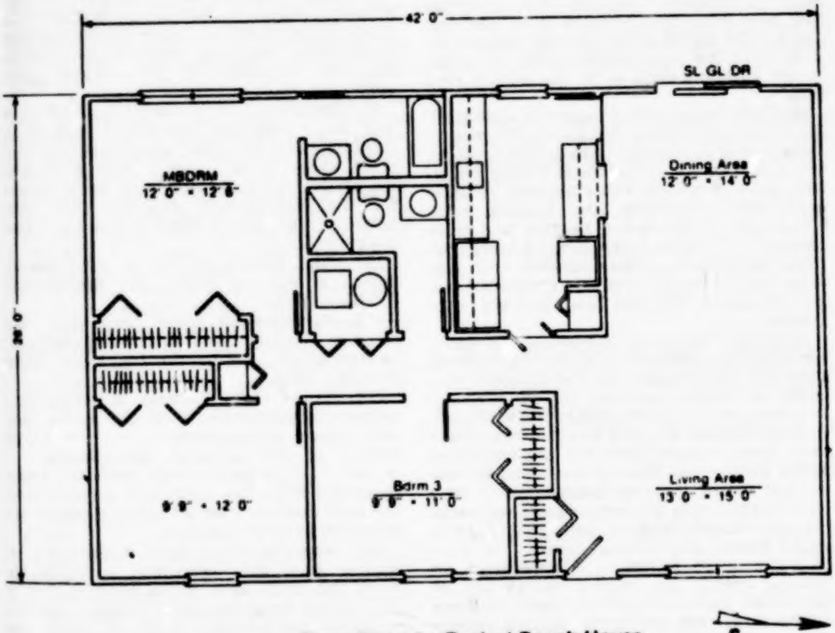
Rear Elevation of a Typical Ranch House



Front Elevation of a Typical Ranch House


Asphalt Shingles
1/2 Plywood Sheathing
2 × 4 Trusses 24 o.c.
1/2 Drywall
2 × 4s 16 o.c.
1/2 Composition Sheathing
Alum. Siding
Carpet
Single Glazing
8'0"
8 Poured Concrete
Note
Basement Ht.
Not to Scale
Bottom of Joist

Section Thru Typical Ranch


42' 0"
SL GL DR
28' 0"
MBDRM
12' 0" × 12' 6"
Dining Area
12' 0" × 14' 0"
9' 9" × 12' 0"
Bdrm 3
9' 9" × 11' 0"
Living Area
13' 0" × 15' 0"
S

Floor Plan of a Typical Ranch House

APPENDIX III TO PART 456—MULTIFAMILY APPLICABILITY CRITERIA AND PROCEDURES FOR DETERMINING USAGE CUTOFF LEVELS

(a) *General.* (1) For those program measures identified in Appendix I, a State or nonregulated utility has the following options regarding audits for dwelling units in residential buildings containing more than four dwelling units (multifamily dwelling units):

(i) Accept the measures indicated by Appendix I for use in multifamily dwelling units.

(ii) Use the DOE multifamily applicability criteria and/or procedures for determining specific cutoffs for heating energy use, cooling energy use, or domestic hot water use in paragraphs (b), (c), (d), and (e) of this appendix for all or some of the program measures identified in Appendix I.

(iii) Develop a method for determining applicability and submit it to DOE for approval in accordance with § 456.306(b).

(2) DOE has not developed multifamily applicability criteria or methods for determining usage cutoff levels for caulking, weatherstripping, duct and pipe insulation, storm or thermal windows, heat reflective and heat absorbing window materials, and IID's. DOE has determined that these measures have the same applicability in multifamily dwelling units as in the prototypical house.

(3) DOE has developed specific applicability criteria for ceiling insulation, floor insulation, wall insulation, clock thermostats, storm or thermal doors, water heater insulation, solar domestic water heaters, replacement solar swimming pool heaters, combined active solar space heating and solar domestic hot water systems, wind energy devices, direct gain systems, window heat gain retardants, window heat loss retardants, solaria/sunspace systems and indirect gain systems.

(4) In addition to the applicability criteria, methods for determining usage cutoff levels have been developed for replacement furnaces or boilers, replacement oil burners, flue dampers, replacement central air-conditioners, solar domestic water heaters, active solar space heating systems and combined active solar space heating and solar domestic hot water systems because they may have significantly different simple paybacks for multifamily dwelling units than for the single family prototypical house. The payback for these measures is dependent on heating energy use, cooling energy use, or hot water use. An audit for each of these measures is required if the annual energy usage or hot water usage in a multifamily dwelling unit is high enough such that a 7-year payback is probable. That level of usage for which a 7-year payback is probable is the cutoff level for that measure.

(b) *Applicability criteria.* (1) *Ceiling Insulation.* Ceiling insulation is applicable when the audit is for ceilings separating a conditioned space from an unconditioned space and when it is physically practical to insulate the ceiling.

(2) *Floor Insulation.* Floor insulation is applicable for floors separating a conditioned space from an unconditioned space and when it is physically practical to insulate the floor.

(3) *Wall Insulation.* Wall insulation is applicable for walls separating a conditioned space from an unconditioned space and when it is physically practical to insulate the walls.

(4) *Storm or Thermal Doors.* A storm or thermal door is applicable if the door separates a conditioned space from an unconditioned space.

(5) *Clock Thermostats.* A clock thermostat is applicable when the thermostat is not part of the furnace.

(6) *Water Heater Insulation.* Water heater insulation is applicable when there is an individual water heater for that multifamily dwelling unit.

(7) *Solar Domestic Water Heaters.* A solar domestic water heater is applicable when there is an individual water heater for that multifamily dwelling unit. This measure may also be subject to a hot water usage cutoff.

(8) *Combined Active Solar Space Heating and Solar Domestic Hot Water Systems.* A combined active solar space heating and solar domestic hot water system is applicable when there is an individual water heater for that multifamily dwelling unit. This measure may also be subject to a hot water usage cutoff.

(9) *Wind Energy Devices.* A wind energy device is not applicable for multifamily dwelling units.

(10) *Replacement Solar Swimming Pool Heaters.* A replacement solar swimming pool heater is not applicable for multifamily dwelling units.

(11) *Direct Gain Systems.* A direct gain systems is applicable when the living area has either a south-facing (+ or −45° of true south) or an integral south-facing (+ or−45° of true south) roof with tilt angle measured from the horizontal greater than the local latitude that is free from major obstruction to solar radiation.

(12) *Window Heat Gain Retardants.* A window heat gain retardant is applicable when the living area has a window that is not shaded from summer sunshine and the residence has substantial use of energy for air conditioning.

(13) *Window Heat Loss Retardants.* A window heat loss retardant is applicable

when the living area has a window with fewer than three panes.

(14) *Solaria/sunspace Systems.* A solaria/sunspace system is applicable when the living area has either a south-facing (+ or −45° of true south), ground level wall, or a south-facing adjacent patio, porch or balcony that is free from major obstruction to solar radiation and can support the weight of a retrofit solaria/sunspace.

(15) *Indirect Gain Systems.* A Thermosyphon Air Panel is applicable when the living area has a south-facing (+ or −45° of true south) wall which is not solid masonry construction, which is accessible for installation from the outside and is free from major obstruction to winter insulation. A Trombe wall is applicable when the living area has a south-facing (+ or −45° of true south) solid masonry wall that is accessible for installation from the outside and is free from major obstruction to solar radiation. A water wall is applicable when the living area has a south-facing (+ or −45° of true south) ground level wall that is free from major obstruction to solar radiation, and the ground level floor is slab on grade or has sufficient structural strength to support a water wall.

(c) *Heating Energy Use Cutoffs.* Heating energy use cutoffs shall be determined for replacement furnances or boilers, replacement oil burners, flue dampers, active solar space heating, and combined solar space heating and solar domestic hot water systems. After all heating energy use cutoff levels for each category of fuel type have been determined, a State has the option to use the lowest of these levels as the cutoff for all of the heating measures. The auditor will audit for a measure if the annual heating energy use of the dwelling is greater than the heating energy use cutoff for that measure. The annual heating energy use of a dwelling unit must be determined by removing the contribution of nonspace heating sources (such as water heating or lighting) from the total energy usage.

(1) *Replacement Furnace or Boiler.* The following formula shall be used to determine the heating energy use cutoff for oil, gas, electric, and heat pump heating systems:

$$E_{RFCO} = \frac{C_{RF}}{7(LEP)(\Delta n)}$$

Where

E_{RFCO}=annual heating energy consumption (based on assumed worst existing system) necessary to give a 7-year simple payback on replacement furnaces or boilers (replacement furnace or boiler energy cutoff)

C_{RF}=installed capital cost−tax credit

7 is the payback period in years

LEP=local energy price, $/unit energy (same energy units as E_{RFCO})

$$\Delta = 1 - \frac{n_{existing}}{n_{new}}$$

Where

$n_{existing}$=assumed efficiency of existing heating system, varies by climate zone and fuel type,

n_{new}=efficiency of new improved heating system, also varies by climate zone and fuel type.

Use the values in the following table for Δn. The values in this table were calculated based on the assumption of a relatively inefficient existing furnace or heat pump. All existing efficiencies were taken from the RCS Model Audit.

Δn

HUD MPS Zone

Fuel	1	2	3	4	5	6	7	8
Electric	.55	.51	.44	.41	.35	.31	.26	.09
Gas	.36	.36	.36	.36	.36	.36	.36	.36
Oil	.20	.20	.20	.20	.20	.20	.20	.20
H.P.	.20	.20	.20	.20	.20	.20	.20	.20

(2) *Replacement Oil Burner.* The following formula shall be used to determine the heating energy use cutoff for replacement oil burners.

$$E_{RBCO} = \frac{C_{RB}}{(LEP)(7)(0.18)}$$

Where

E_{RBCO}-annual heating energy consumption necessary to give a 7-year payback on a replacement oil burner (replacement oil burner energy cutoff)

C_{RB}=cost of installed replacement oil burner − tax credit

LEP=local energy price, $/unit energy (same energy units as E_{RBCO})

7 is the payback period in years

0.18 is a high estimate of the proportion of heating energy that may be saved due to a replacement oil burner.

(3) *Flue Damper.* The following formula shall be used to determine the heating energy use cutoff for flue dampers for gas heating systems.

$$E_{FDCO} = \frac{C_{FD}}{(LEP)(7)(0.1)}$$

Where

E_{FDCO} = annual energy consumption necessary to give a 7-year payback on a flue damper (flue damper energy cutoff)

C_{FD} = installed flue damper cost − tax credit

LEP = local energy price, \$/unit energy (same energy units as E_{FDCO})

7 is the payback period in years

0.1 is a high estimate of the proportion of heating energy that may be saved due to a flue damper.

(4) *Active Solar Space Heating.* (i) The cost of active solar space heating systems depends on insulation as well as heating energy use, which makes it difficult to produce a generic formula that will indicate the annual heating energy use cutoff level which corresponds to a 7-year simple payback. Therefore, a State shall determine the heating energy use cutoff level by calculating the simple payback associated with a range of annual heating energy uses and then, by successive approximation, determine the heating energy use cutoff level that corresponds to a 7-year simple payback.

(ii) Use the following procedure to determine the heating energy use cutoff for solar space heating:

(A) Determine savings (using each heating fuel type) and costs for active solar space heating using an approved audit procedure, such as the Model Audit, for a range of annual heating energy uses. For each fuel, choose an annual heating energy use cutoff level, based on these calculations, which corresponds to a 7-year simple payback.

(B) Calculations should assume: no obstruction to solar radiation; due south orientation of collectors; a solar savings fraction consistent with the values given in the Model Audit for the climate (solar savings fraction is the percent of the heating load provided by the Solar system); enough roof area to provide the solar savings fraction indicated above; and the tilt of the collector should be optimal for the specified latitude.

(5) *Combined Solar Space Heating and Solar Domestic Hot Water Systems.* (i) The cost of combined active solar space heating and solar domestic hot water systems depends on insulation as well as heating energy use which makes it difficult to produce a generic formula that will indicate the annual heating energy use cutoff level which corresponds to a 7-year simple payback. Therefore, a State shall determine the heating energy use cutoff level by calculating the simple payback associated with a range of annual heating energy uses and then by successive approximations determine the heating energy use cutoff level that corresponds to a 7-year simple payback.

(ii) Use the following procedures to determine the cutoff for combined solar space heating and domestic hot water systems.

(A) Determine savings (using each heating fuel type) and costs for active solar space heating using an approved audit procedure, such as the Model Audit, for a range of annual heating energy uses. For each fuel, choose an annual heating energy use cutoff level, based on these calculations, which corresponds to a 7-year simple payback.

(B) Calculations should assume: no obstruction to solar radiation; due south orientation of collectors; a solar savings fraction consistent with the values given in the Model Audit for the climate (solar savings fraction is the percent of the heating load provided by the solar system); enough roof area to provide the solar savings fraction indicated above; the tilt of the collector should be optimal for the specified latitude; and the hot water usage is 80 gallons per day with the water temperature set at 120° F.

(d) *Cooling Energy Use Cutoffs.* (1) Cooling energy use cutoffs shall be determined for replacement central air-conditioners.

(2) *Replacement Central Air-Conditioners.* (i) The following formula shall be used to determine the cooling energy use cutoff for replacement central air-conditioners:

$$E_{ACCO} = \frac{C_{RAC}}{7(LEP)(\Delta COP)}$$

Where

C_{RAC} = installed cost of replacement central air-conditioner

$$\Delta COP = 1 \quad \frac{COP^{existing}}{COP^{new}}$$

7 is the payback period in years

LEP = local energy price \$/unit energy

$COP_{existing}$ = assumed coefficient of performance of existing system

COP_{new} = improved coefficient of performance of new system.

(ii) The value of 0.46 may be used for ΔCOP. This value is based on an assumed existing SEER of 6.6 (COP of 1.9) and a new SEER of 12.0 (COP of 3.5).

(iii) An audit should be conducted for replacement central air-conditioners if the annual cooling energy use of the dwelling unit is greater than the cooling energy cutoff. The annual cooling energy use of the dwelling unit shall be determined by removing the contribution of noncooling sources, such as lighting, appliances, and water heating) from the total energy consumption.

(e) *Domestic Hot Water Use Cutoff.* (1) A domestic hot water use cutoff level shall be determined for solar domestic hot water systems. The cost of solar domestic water heater systems depends on insulation as well as hot water use which makes it difficult to produce a generic formula which will indicate the hot water use cutoff level which corresponds to a 7-year simple payback. Therefore, a State shall determine the simple payback associated with a range of daily hot water uses and then by successive approximation determine the hot water use cutoff level that corresponds to a 7-year simple payback.

(2) *Solar Domestic Hot Water System.* Use the following procedures to determine the domestic hot water use cutoff for solar domestic hot water systems.

(i) Determine savings (for each water heating fuel type) and costs for solar domestic hot water, using an approved audit procedure, such as the DOE Model Audit, for a range of gallons per day of hot water usage.

(ii) Based on the sample calculations, determine what is the gallons-per-day cutoff level for each fuel type which corresponds to a 7-year simple payback. Calculations should assume: no obstruction to solar radiation; due south orientation of collectors; a solar savings fraction consistent with the values given in the Model Audit for the climate (the solar savings fraction is the percent of the water heating load provided by the solar system); enough roof area to provide the solar savings fraction indicated above; and the tilt of the collector should be optimal for the specified latitude.

(iii) This gallons-per-day number shall be used as a cutoff level for determining whether to audit for a solar domestic hot water system in a multifamily dwelling unit. A method must be developed for auditors to determine gallons-per-day usage at the dwelling unit. (For example, the DOE Model Audit determines gallons-per-day usage using the number of people in residence and the presence of a dishwasher and/or a washing machine.)

PART 459—RESIDENTIAL ENERGY EFFICIENCY PROGRAM

Sec.
459.101 Purpose and scope.
459.102 Availability of financial assistance.
459.103 Award and administration of financial assistance.

AUTHORITY: Part 5 of Title II of the National Energy Conservation Policy Act, 42 U.S.C. 8235 *et seq.*, as added by Subtitle C of Title V of the Energy Security Act; Department of Energy Organization Act, 42 U.S.C. 7101 *et seq.*

SOURCE: 47 FR 19982, May 10, 1982, unless otherwise noted.

§ 459.101 Purpose and scope.

As required by section 265(b) of the National Energy Conservation Policy Act, as amended, 42 U.S.C. 8235d, this part sets forth the procedures for awarding and administering financial assistance under the Residential Energy Efficiency Program.

§ 459.102 Availability of financial assistance.

No financial assistance will be made available under this part without a prior solicitation issued in accordance with 10 CFR Part 600 and then only subject to the availability of appropriated funds. The Department of Energy will not consider any unsolicited proposal for financial assistance under this part.

§ 459.103 Award and administration of financial assistance.

The award and administration of financial assistance under this part are governed by:

(a) Part 5 of Title II of the National Energy Conservation Policy Act, as amended, 42 U.S.C. 8235 *et seq.*; and

(b) Applicable provisions of 10 CFR Part 600, insofar as these provisions do not conflict with Part 5 of Title II of the National Energy Conservation Policy Act, as amended.

PART 463—ANNUAL REPORTS FROM STATES AND NONREGULATED UTILITIES ON PROGRESS IN CONSIDERING THE RATEMAKING AND OTHER REGULATORY STANDARDS UNDER THE PUBLIC UTILITY REGULATORY POLICIES ACT OF 1978

Sec.
463.1 Purpose and scope.
463.2 Definitions.
463.3 Reporting requirement.

AUTHORITY: Public Utility Regulatory Policies Act of 1978, Pub. L. 95-617 (16 U.S.C. 2601 *et seq.*); Department of Energy Organization Act, Pub. L. 95-91 (42 U.S.C. 7101 *et seq.*).

SOURCE: 44 FR 47321, Aug. 13, 1979, unless otherwise noted.

§ 463.1 Purpose and scope.

This part establishes the manner in which State regulatory authorities and certain nonregulated electric and gas utilities shall report to DOE under sections 116 and 309 of the Public Utility Regulatory Policies Act of 1978 (PURPA) Pub. L. 95-617, 92 Stat. 3117 *et seq.*, with respect to their progress in considering the ratemaking and other regulatory standards established by sections 111(d), 113(b) and 303(b) of PURPA.

§ 463.2 Definitions.

As used in this part—

"Covered electric utilities" and "covered nonregulated electric utilities" mean those electric utilities whose total sales of electric energy for purposes other than resale exceeded 500 million kilowatt-hours during any calendar year beginning after December 31, 1975, and before the immediately preceding calendar year.

"Covered gas utilities" and "covered nonregulated gas utilities" mean those gas utilities whose total sales of natural gas for purposes other than resale exceeded 10 billion cubic feet during any calendar year beginning after December 31, 1975, and before the immediately preceding calendar year.

"DOE" means the Department of Energy.

"Electric utility" means any person, State agency or federal agency which sells electric energy.

"Federal agency" means an executive agency (as defined in section 105 of Title 5 of the United States Code).

"Gas utility" means any person, State agency or Federal agency engaged in the local distribution of natural gas and the sale of natural gas to any ultimate consumer of natural gas.

"Nonregulated electric utility" means any electric utility with respect to which no State regulatory authority has ratemaking authority.

"Nonregulated gas utility" means any gas utility with respect to which no State regulatory authority has ratemaking authority.

"Person" means an individual, partnership, corporation, unincorporated association or any other group, organization or entity.

"PURPA" means the Public Utility Regulatory Policies Act of 1978, Pub. L. 95-617, 92 Stat. 3117 *et seq.*

"Rate" means (a) any price, rate, charge or classification made, demanded, observed, or received with respect to the sale of electric energy by an electric utility to an electric consumer or the sale of natural gas to a gas consumer, (b) any rule, regulation, or practice respecting any such rate, charge or classification, and (c) any contract pertaining to the sale of electric energy to an electric consumer or the sale of natural gas to a gas consumer.

"Ratemaking authority" means authority to fix, modify, approve or disapprove rates.

"Sale" means a transfer to a purchaser for consideration, and when used with respect to electric energy includes any exchange of electric energy, and when used with respect to natural gas includes any exchange of natural gas.

"State" means a State, the District of Columbia, and Puerto Rico.

"State agency" means a State agency, political subdivision thereof, and any agency or instrumentality of either.

"State regulatory authority" means any State agency which has ratemaking authority with respect to the sale of electric energy by any electric utility, or the sale of natural gas by any gas utility, other than by such State agency, and in the case of an electric utility with respect to which the Tennessee Valley Authority has ratemaking authority, such term means the Tennessee Valley Authority.

§ 463.3 Reporting requirements.

(a) Each State regulatory authority, with respect to each covered electric and gas utility for which it has ratemaking authority, and each covered nonregulated electric and gas utility shall report to DOE, on or before the effective date of this rule in 1982, and by February 28 of each year from 1983 through 1989, on its progress in considering the ratemaking and other regulatory standards established by sections 111(d), 113(b) and 303(b) of PURPA. Any State regulatory authority or covered nonregulated electric and gas utility which has, on or before the date that this rule becomes effective, previously filed a report which covers any portion of the year 1981 shall not be required to file any other report on this subject in 1982.

(b) The requirements of paragraph (a) of this section do not apply to the operations of an electric or gas utility, or to proceedings respecting such operations, to the extent that such operations or proceedings relate to sales of electric energy or natural gas for purposes of resale.

(c) The reporting period for reports required by paragraph (a) of this section shall be the 12 month period ending December 31 of the year in which the report is due, except that the reporting period for the report due on the effective date of this rule shall be July 1, 1980, through December 31, 1981.

(d) The report required by paragraph (a) must be submitted on Form ERA-166: PURPA Annual Report on Electric and Gas Utilities, as it may be revised from time to time. (OMB control number 1904-0060)

[44 FR 47321, Aug. 13, 1979, as amended at 46 FR 63209, Dec. 31, 1981; 47 FR 33680, Aug. 4, 1982]

PART 465—ENERGY EXTENSION SERVICE

Sec.
465.1 Purpose and scope.
465.2 Definitions.
465.3 Comprehensive Energy Extension Service program.
465.4 National Advisory Board.
465.5 Financial assistance.
465.6 Annual State applications.
465.7 Submission and contents of State plans.
465.8 Approval of annual State applications and State plans.
465.9 Development and implementation of a State plan by the Director.
465.10 Administrative review.
465.11 Prohibited expenditures.
465.12 Reports.
465.13 Administration of financial assistance.

AUTHORITY: National Energy Extension Service Act, enacted as title V of the Energy Research and Development Administration Authorization Act of 1977, title V of Pub. L. 95-39, 91 Stat. 191 *et seq.* (42 U.S.C. 7001 *et seq.*); Department of Energy Organization Act, Pub. L. 95-91, 91 Stat. 965 *et seq.* (42 U.S.C. 7101 *et seq.*); Federal Grant and Cooperative Agreement Act of 1977, Pub. L. 95-224, 92 Stat. 3 *et seq.* (41 U.S.C. 501 *et seq.*); Section 1007(b) of the Omnibus Budget Reconciliation Act of 1981, Pub. L. 97-35, 95 Stat. 611 (42 U.S.C. 7270 Note); E.O. 12009 (42 FR 46267); E.O. 12291 (46 FR 13193).

SOURCE: 48 FR 32724, July 18, 1983, unless otherwise noted.

§ 465.1 Purpose and scope.

This part contains the regulation adopted by DOE to establish a comprehensive Energy Extension Service program which shall—

(a) Establish a positive energy outreach program directed toward small businesses and individual energy users and the organizations that influence their energy consumption;

(b) Stimulate, provide for and supplement programs for the conduct of evaluation, planning and other technical assistance of energy conservation efforts, including energy outreach activities of States; and

(c) Provide financial and technical assistance to the States for State plans which contribute to the implementation of the comprehensive Energy Extension Service program.

§ 465.2 Definitions.

As used in this part—

Act means the National Energy Extension Service Act, title V of Pub. L. 95-39, 42 U.S.C. 7001 *et seq.*

Assistant Secretary means the Assistant Secretary for Conservation and Renewable Energy or official to whom the Assistant Secretary's functions may be redelegated by the Secretary.

Barriers to energy conservation means problems or obstacles identified by small energy users which prevent or hinder them from adopting conservation techniques and technologies.

Building means any structure which includes provisions for a heating, cooling or hot water system, or which is used as a residential dwelling unit.

Community action agency means a private corporation or public agency established pursuant to the Economic Opportunity Act of 1964, Pub. L. 88-

452, 42 U.S.C. 2701 *et seq.*, which is authorized to administer funds received from Federal, State, local or private funding entities to assess, design, operate, finance and oversee antipoverty programs.

Conservation techniques and technologies means actions likely to result in energy conservation.

Deputy Assistant Secretary means the Deputy Assistant Secretary for Technical and Financial Assistance or any official to whom the Deputy Assistant Secretary's functions may be redelegated by the Assistant Secretary.

Director means the Director of the EES office of DOE.

DOE means the Department of Energy.

Energy audit means a procedure to measure the consumption or cost of energy in order to identify conservation techniques and technologies in a building or industrial process.

EES means Energy Extension Service.

EES office means the national office of DOE established to develop and carry out the comprehensive EES program in accordance with the provisions of this part.

Energy conservation means efficient energy use or the utilization of renewable energy resources.

Governor means the chief executive officer of a State and the Mayor of the District of Columbia, or a person fully designated in writing by the Governor to act upon his or her behalf.

Grantee means a State or entity of the State named in the notice of grant award as the recipient of financial assistance provided under this part.

Operations Office Manager means the manager of a DOE Operations Office or the manager's designee, or any official to whom the manager's functions may be redelegated by the Secretary.

SECP means the State energy conservation plans developed and implemented pursuant to 10 CFR Part 420.

Secretary means the Secretary of the Department of Energy.

Service means technical assistance, instruction, information dissemination, energy audit or a practical demonstration concerning one or more conservation techniques and technologies.

Small business means an independently owned concern which together with its affiliates is not dominant in its field and which does not have more than 400 employees.

Small energy users means residential consumers, individuals and groups of individuals, small businesses including agricultural and commercial establishments, and units of State and local governments.

Special State project means a unique or innovative activity which is likely to bring about energy conservation in furtherance of the objectives of the Act, and which is not part of a State plan.

State means any State of the United States, the District of Columbia, the Commonwealth of Puerto Rico, Guam, the Virgin Islands, American Samoa, the Commonwealth of the Northern Mariana Islands, and the Trust Territory of the Pacific Islands.

State program means a set of related services provided to a target audience which is used to implement a portion of a State plan.

Target audience means the persons intended to receive services provided under a State program.

Technical assistance means assistance, other than direct financial assistance, including instruction, expert advice, information dissemination and practical demonstrations.

Technical support means activities provided by a State, such as specialized analyses, preparation of materials, training or other activities, which are necessary to implement a State plan effectively.

[48 FR 32724, July 18, 1983, as amended at 55 FR 41327, Oct. 10, 1990]

§ 465.3 Comprehensive Energy Extension Service program.

(a) DOE has established the EES office, administered by a Director, to develop and carry out the comprehensive EES program established by this part.

(b) The comprehensive EES program shall identify, develop and demonstrate in a practical manner, opportunities for energy conservation. This program shall be developed and implemented with particular regard for increasing the capability of small energy users to make informed energy decisions.

(c) The Director shall implement the comprehensive EES program by—

(1) Carrying out activities, through technical assistance where appropriate, for the identification, development and practical demonstration of opportunities for energy conservation;

(2) Collecting information and undertaking actions to eliminate barriers to energy conservation identified by small energy users;

(3) Carrying out activities that shall encourage the sharing of information, experience and meterials among the States regarding the comprehensive EES program;

(4) Providing financial assistance through the Operations Office Manager for the implementation of a State plan; and

(5) Providing technical assistance for the development, implementation or modification of a State plan.

(d) The Director shall take such steps as he or she may determine to be necessary to minimize conflict between existing services in the private sector that are similar to the services provided under the comprehensive EES program.

§ 465.4 National Advisory Board.

(a) The Secretary shall appoint a National Advisory Board which shall consist of not less than 15 nor more than 20 members. The members shall include persons representative of the interests of State, county and local governments, State universities, community colleges, community action agencies, energy users, small businesses and agriculture.

(b) The Secretary shall designate one member of the Board to serve as Chairman and shall provide the Board with the services and facilities as may be necessary to carry out its functions.

(c) The Board shall carry on a continuing review of the operation of the comprehensive EES program established by § 465.3 and the State plans approved by the Operations Office Manager according to § 465.8, for the purpose of evaluating their effectiveness in achieving the objectives of the Act and determining how their operation might be improved in order to further these objectives.

(d) The Board shall report annually to the Congress, the Secretary, and the Director on the status of the comprehensive EES program, including any recommendations the Board may have for administrative or legislative changes needed to improve operation of the comprehensive EES program.

(e) The Secretary shall reimburse Board members for the full amount of any expenses necessarily incurred by them in the performance of their duties as such.

§ 465.5 Financial assistance.

(a) The Operations Office Manager shall provide financial assistance from funds available for any fiscal year to each State having an approved annual application according to § 465.8.

(b) Financial assistance shall be allocated among the States from funds available for any fiscal year based on the following formula—

(1) One-half shall be divided equally among all States; and

(2) One-half shall be divided on the basis of the State's population as reported by the Department of Commerce, Bureau of the Census, in the most recent decennial census.

(c) If a State's allocation of financial assistance is not obligated by the Operations Office Manager during the fiscal year, the allocation shall be reallocated among the States according to paragraph (b) of this section for the program's next funding cycle.

(d) Notwithstanding the provisions of paragraph (b) of this section, the Director may reserve from the funds appropriated for any fiscal year an amount to provide financial assistance to States for special State projects. This amount shall be determined by the Director, but in no event shall exceed 10 percent of the appropriated funds.

(e) Each State shall provide cash, in kind contributions, or both for EES activities in an amount totalling not less than 20 percent of the Federal funds allocated to it for this program. Cash and in kind contributions used to meet this State cost-sharing requirement are subject to the limitations on expenditures described in § 465.11(a). The type and amount of State cost-sharing shall be identified in the annual application.

(f) The budget period covered by the financial assistance provided to a State according to § 465.5(b) will be set by the State within parameters established by DOE.

§ 465.6 Annual State applications.

(a) To be eligible for financial assistance under this part, a State shall submit to the Operations Office Manager an original and two copies of an annual State application executed by the Governor. The date for submission of annual State applications shall be determined by DOE.

(b) An annual State application shall contain—

(1) The State plan or modifications of it, as required by § 465.7 (a) and (b) respectively;

(2) A total program budget broken out by object class category and by source of funding for the budget period for which financial assistance will be provided;

(3) A budget and listing of milestones for each State program or function contained in the State plan for the budget period for which financial assistance will be provided;

(4) A description of policies and procedures employed by the State which assure that financial assistance provided under this part does not supplant the expenditure of State or local funds for the same purposes, but rather supplements Federal, State, or local funds, and increases the expenditure of the State or local funds to the maximum extent practicable;

(5) A written summary and chronology of the procedures which were used to provide organizations and individuals with opportunity to comment on the State plan prior to or during its development. The opportunity to comment shall be provided to representatives of energy users and producers; State, county, and local officials; State universities and community colleges; cooperative extension services; community action agencies; and other public, private, or nonprofit organizations which are involved in active energy outreach activities. The written summary shall include—

(i) The name of the organizations afforded an opportunity to comment; and

(ii) How the comments received affected the contents of the State plan.

(6) A description of anticipated environmental impacts of any services which include the modification of buildings or structures to provide a practical demonstration of conservation techniques and technologies.

(c) The Governor may request an extension of the annual submission date by submitting a written request to the Operations Office Manager not less than 15 days prior to the date referred in the paragraph (a) of this section. The extension shall be granted if, in the Operations Office Manager's judgment, acceptable and substantial justification is shown and the extension would further the objectives of the Act.

(Approved by the Office of Management and Budget under control numbers 1904-0041 and 1901-0127)

§ 465.7 Submission and contents of State plans.

(a) A State shall submit a State plan with—

(1) The first annual State application; and

(2) The annual State application submitted every 3 years thereafter.

(b) A State shall submit, with the annual State application, modifications to the State plan, if appropriate, for the years not referred to in paragraph (a) of this section.

(c) A State plan shall be developed for a 3-year period and contain—

(1) A description of the objectives to be achieved for the 3-year period by implementation of the State plan, which shall include—

(i) Why the objectives were selected, with particular reference to potential energy savings, increased use of renewable resources and the types and numbers of people affected;

(ii) How the State programs included in the State plan, and the emphasis and funding given to each, together represent a strategy to achieve these objectives;

(iii) How implementation of the State plan shall supplement and be coordinated with other energy conservation programs being carried out in the State with Federal funds or under other Federal laws; with particular reference to university programs providing extension services and the State's SECP;

(iv) How existing organizations will be used to the optimum extent to assist in the implementation of the State plan;

(v) How the State plan provides for information dissemination to small businesses and addresses organizations which influence the energy consumption of small energy users;

(vi) How the State plan makes energy audits available to small energy users, within personnel and funding limitations;

(2) A description for each State program in the State plan, which shall include—

(i) The target audience, why it was selected and the estimated number of persons which the State program expects to reach;

(ii) The services to be provided, including—

(A) How the services will meet the needs of the target audience;

(B) The conservation techniques and technologies to be used in each service;

(C) The type and estimated number of any energy audits if any are included; and

(D) The geographic areas in which the services shall be delivered and why these areas were selected;

(iii) Any technical support which is necessary to provide the services, including the type of organization that will provide the technical support and why that type of organization was selected; and

(iv) The type of organization which shall implement the State program and the type of any other organizations which shall provide a service to the target audience, why the selection was made and the approximate number of any new personnel to be employed to implement the State program;

(3) A description of the organization which shall administer the overall development and implementation of the State plan, which shall include—

(i) Why the administering organization was selected;

(ii) The provisions made for coordination between the administering organization and any other organization assisting in the implementation of the State plan; and

(iii) The relationship between the administering organization and the grantee if the two are not the same;

(4) A description of the methods and procedures which shall be used to—

(i) Identify barriers to energy conservation from responses which shall be obtained from target audiences;

(ii) Communicate information concerning the barriers to energy conservation to organizations within the State that have the capability or authority to remove or influence the barriers; and

(iii) Periodically report the results of such communication to the target audiences identified in paragraph (c)(4)(i) of this section;

(5) A description of the administrative procedures to be used in the implementation of the State plan which shall include—

(i) The procedures to be used to respond to suggestions and inquiries from the public regarding energy conservation;

(ii) The procedures to be used to publicize and disseminate up-to-date and easily understood information on the services available to small energy users under the State plan and under other Federal programs and activities of the State regarding conservation techniques and technologies; and

(iii) The system to be used to review, for technical accuracy, any publication or other material which the State shall prepare or use in a State program;

(6) A description of the purpose, methods and procedures of the independent evaluation activities, if any, that the State shall undertake regarding the State programs or services;

(7) A description of any additional technical support not described in (c)(2)(iii) of this section which is required to facilitate implementation of

the State plan. If existing organizations are not available to provide this additional technical support or the technical support identified in paragraph (c)(2)(iii), the State may propose to establish a technical support institute, at one or more colleges or universities designated by the Governor. The purpose of the technical support institute shall be to assist in the implementation of the State plan by providing analyses and technical support which is required for effective implementation of the State plan. If such an institute is proposed, the State shall provide a detailed justification which shall describe—

(i) Why the institute is needed;

(ii) How the institute specifically relates to the implementation of the State plan; and

(iii) The purpose, location, size, and specific activities of the institute; and

(8) A description of the procedures that the grantee will use to achieve timely implementation of the State plan.

(Approved by the Office of Management and Budget under control number 1904-0041)

§ 465.8 Approval of annual State applications and State plans.

(a) After receipt of an application, the Operations Office Manager may request the State to submit within a reasonable period of time any amendments necessary to make the application complete or amendments to bring the application into compliance with the requirements of this part. The Operations Office Manager shall attempt to resolve any dispute over an application informally and to seek voluntary compliance. If a State fails to submit timely appropriate amendments to complete the application, the Operations Office Manager may reject the application as incomplete in a written decision, including a statement of reasons, which shall be subject to administrative review under § 465.10 of this part.

(b) On or before 60 days from the date that a timely filed application is complete, the Operations Office Manager shall decide whether DOE shall make a financial assistance award. The Operations Office Manager may—

(1) Approve the application in whole or in part to the extend that—

(i) The State plan meets the objectives of the Act;

(ii) The annual State application and the State plan meet the requirements of §§ 465.6 and 465.7, respectively; and

(iii) Implementation of the State plan by the State conforms to the requirements of this part;

(2) Approve the application in whole or in part subject to special conditions designed to ensure compliance with the requirements of this part; or

(3) Disapprove the application if it does not conform to the requirements of this part.

[55 FR 41327, Oct. 10, 1990]

§ 465.9 Development and implementation of a State plan by the Director.

(a) The Director shall develop a State plan which meets the requirements of § 465.7, if—

(1) A State does not submit an annual State application in accordance with § 465.6; or

(2) The Operations Office Manager finally disapproves an annual State application according to § 465.10.

(b) Prior to developing a State plan under this section, the Director shall provide written notice and an opportunity for comment to the Governor.

(c) A State plan developed by the Director shall be transmitted to the Governor of the State and shall not be implemented for 90 days after the date of transmittal. Notwithstanding any provisions of this section to the contrary, no State plan developed by the Director according to paragraph (a) of this section shall be implemented if the Governor, within the 90-day period, notifies the Secretary in writing of his or her objection to the implementation of the State plan.

(d) In implementing a State plan developed according to this section to which the Governor has not objected during the 90-day period referred to in paragraph (c) of this section, the Director shall make maximum use of regional, State, or local organizations which deliver services which are appropriate for purposes of this part. The Director shall coordinate his or r activities in implementing the te plan with all other regional, te, or local organizatons which del- r services which are related to, but t directly involved in, the implemen- tion of the State plan.

(c) A State plan developed by the Di- tor for a State whose financial as- ance has been terminated accord- g to § 465.10, shall provide for the tinuation of all activities under the te plan which meet the require- ts of this part.

§ 465.10 Administrative review.

(a) A State shall have 20 days from e date of receipt of a decision under § 465.8 to file a notice requesting ad- inistrative review. If the State does t timely file such a notice, the deci- n under § 465.8 shall become final r DOE.

(b) A notice requesting administra- ve review shall be filed with the Op- rations Office Manager and shall be ccompanied by a written statement ntaining supporting arguments. If e Operations Office Manager has approved the entire application, the tate may request a public hearing.

(c) A notice of any other document hall be deemed filed under this sec- on upon receipt.

(d) On or before 15 days from re- eipt of a notice requesting adminis- rative review which is timely filed, the Operations Office Manager shall forward to the Deputy Assistant Sec- retary, the notice requesting adminis- trative review, the decision under § 465.8 as to which administrative review is sought, a draft recommended final decision for concurrence, and any other relevant material.

(e) If the State requests a public hearing on the disapproval of an entire application, the Deputy Assist- ant Secretary, within 15 days, shall give actual notice to the State and FEDERAL REGISTER notice of the date, place, time, and procedures which shall apply to the public hearing. Any public hearing under this section shall be informal and legislative in nature.

(f) On or before 45 days from receipt of documents under paragraph (d) or the conclusion of the public hearing, whichever is later, the Deputy Assistant Secretary, shall concur in, concur in as modified, or issue a substitute for the recommended decision of the Operations Office Manager.

(g) On or before 15 days from the date of receipt of the determination under paragraph (f) to the section, the Governor may file an application for discretionary review by the Assistant Secretary. On or before 15 days from filing, the Assistant Secretary shall send a notice to the Governor whether the Deputy Assistant Secretary's determination will be reviewed. If the Assistant Secretary grants review, a decision shall be issued no later than 60 days from the date review is granted. The Assistant Secretary may not issue a notice or decision under this paragraph without the concurrence of the DOE Office of General Counsel.

(h) A decision under paragraph (f) of this section shall be final for DOE if there is no review under paragraph (g) of this section. If there is review under paragraph (g) of this section, the decision thereunder shall be final for DOE and no appeal shall lie elsewhere in DOE.

(i) Prior to the effective date of the termination or suspension of a grant award for failure to implement an approved State plan in compliance with the requirements of this part, a grantee shall have the right to written notice of the basis for the enforcement action and of the opportunity for public hearing before the DOE Financial Assistance Appeals Board notwithstanding any provisions to contrary of 10 CFR 600.26, 600.28(b), 600.29, 600.121(c), and 600.443. To obtain a public hearing, the grantee must request an evidentiary hearing, with prior FEDERAL REGISTER notice, in the election letter submitted under rule 2 of 10 CFR 1024.4 and the request shall be granted notwithstanding any provisions to the contrary of rule 2.

[55 FR 41328, Oct. 10, 1990]

§ 465.11 Prohibited expenditures.

(a) No financial assistance provided to a State under this part shall be used—

(1) For construction, such as construction of mass transit systems and exclusive bus lanes, or for construction or repair of buildings or structures;

(2) To purchase land, a building or structure or any interest therein;

(3) To subsidize fares for public transportation;

(4) To subsidize utility rate demonstrations or State tax credits for energy conservation;

(5) To conduct or purchase equipment to conduct research, development or demonstration of conservation techniques and technologies not commercially available; or

(6) To purchase or install equipment or materials for energy conservation building retrofits or weatherization.

(b) No more than 20 percent of the financial assistance awarded to the State for this program shall be used to purchase office supplies, library materials, or other equipment whose purchase is not otherwise prohibited by this section.

(c) Demonstrations of commercially available conservation techniques and technologies are permitted, and are not subject to the prohibitions of § 465.11(a) (1) and (6), or to the limitation on equipment purchases of § 465.11(b).

(b) A State may use regular or revolving loan mechanisms to fund EES services which are consistent with this part and which are included in the State's approved EES plan. The State may use loan repayments and any interest on the loan funds only for activities which are consistent with this part and which are included in the State's approved EES plan.

§ 465.12 Reports.

Each State receiving financial assistance under this part shall submit to the Operations Office Manager a quarterly program report and a quarterly financial statement. The program performance report shall contain such information as the Director may prescribe in order to monitor effectively the implementation of the State plan. The reports shall be submitted to the Operations Office Manager within 30 days following the end of each calendar year quarter.

(Approved by the Office of Management and Budget under control number 1901-0127)

§ 465.13 Administration of financial assistance.

Grants provided under this part shall comply with applicable law including, but without limitation, the requirements of—

(a) Office of Management and Budget Circular A- 97, entitled "Rules and Regulations Permitting Federal Agencies to Provide Specialized or Technical Services to State and Local Units of Government under Title III of the Intergovernmental Coordination Act of 1968;"

(b) DOE Financial Assistance Rules (10 CFR Part 600); and

(c) Other procedures which DOE may from time to time prescribe for the administration of financial assistance under this part.

PART 470—APPROPRIATE TECHNOLOGY SMALL GRANTS PROGRAM

Sec.
470.1 Purpose and scope.
470.2 Definitions.
470.10 Establishment of program.
470.11 Eligibility requirements.
470.12 Management.
470.13 Program solicitation.
470.14 Evaluation and selection.
470.15 Allocation of funds.
470.16 Cost sharing and funds from other sources.
470.17 General requirements.
470.18 Debriefing.
470.20 Dissemination of Information.

Authority: Energy Research and Development Administration Appropriation Authorization of 1977, Pub. L. 95-39; Energy Reorganization Act of 1974, Pub. L. 93-438; Department of Energy Organization Act, Pub. L. 95-91.

Source: 45 FR 8928, Feb. 8, 1980, unless otherwise noted.

Editorial Note: The recordkeeping requirements contained in this part have been approved by the Office of Management and Budget under control number 1904-0036.

§ 470.1 Purpose and scope.

This part contains guidelines for the implementation of the appropriate technology small grants program required to be prescribed by section 113 of the Act.

§ 470.2 Definitions.

As used in this part—

"Act" means the Energy Research and Development Administration Appropriation Authorization of 1977, Pub. L. 95-39, 91 Stat. 180, 42 U.S.C. 5907a.

"Affiliate" means a concern which, either directly or indirectly, controls or has the power to control another concern, is controlled by or is within the power to control of another concern or, together with another concern, is controlled by or is within the power to control of a third party, taking into consideration all appropriate factors, including common ownership, common management and contractual relationships.

"Concern" means any business entity organized for profit (even if its ownership is in the hands of a nonprofit entity) with its principal place of business located in the United States. "Concern" includes, but is not limited to, an individual, partnership, corporation, joint venture, association or cooperative. For the purpose of making affiliation findings, any business entity, whether organized for profit or not, and any foreign business entity (i.e., any entity located outside the United States), shall be included.

"DOE" means the Department of Energy.

"DOE-AR" means the Department of Energy Assistance Regulations (10 CFR Part 600).

"DOE-PR" means the Department of Energy Procurement Regulations (41 CFR Part 9).

"Indian tribe" means any tribe band, nation, or other organized group or community of Indians (including any Alaska native village or regional or village corporation as defined in or established pursuant to the Alaska Native Claims Settlement Act, Pub. L. 92-203, 85 Stat. 688, which (1) is recognized as eligible for the special programs and services provided by the United States to Indians because of their status as Indians; or (2) is located on, or in proximity to, a Federal or State reservation or rancheria, acting through its tribal organization.

"Local agency" means an agency or instrumentality of a local government.

"Local government" means a local unit of government including specifically a county, municipality, city, town, township, local public authority, special district, intrastate district, council of governments, sponsor group representative organization, and other regional or intrastate government entity.

"Local nonprofit organization or institution" means any corporation trust, foundation, trade association, or other institution (1) which is entitled to exemption under section 501(c)(3) of the Internal Revenue Code or (2) which is not organized for profit and no part of the net earnings of which insure to the benefit of any private shareholder or individual.

"Program" means the appropriate technology small grants program.

"Small business" means a concern, including its affiliates, which is organized for profit, is independently owned and operated, is not dominant in the field of operation in which it is submitting a proposal to DOE, and has 100 employees or less.

"Standard Federal regions" means the 10 standard Federal regions established by Office of Management and Budget Circular A-105, entitled "Standard Federal Regions."

"State" means any of the several States of the United States, the District of Columbia, the Commonwealth of Puerto Rico, and any territory or possession of the United States.

"State agency" means an agency or instrumentality of a State government.

"State government" means the government of a State, or an interstate organization.

"Support" means financial support or award under the program by grants, cooperative agreements or contracts.

"Tribal organization" means the recognized governing body of an Indian tribe, or any legally established organization of Native Americans which is controlled, sanctioned, or chartered by such governing body.

§ 470.10 Establishment of program.

There is established, under direction of the Assistant Secretary for Conservation and Solar Energy of DOE, an appropriate technology small grants program for the purpose of encouraging development and demonstration of, and the dissemination of information with respect to, energy-related systems and supporting technologies appropriate to—

(a) The needs of local communities and the enhancement of community self-reliance through the use of available resources;

(b) The use of renewable resources and the conservation of non-renewable resources;

(c) The use of existing technologies applied to novel situations and uses;

(d) Applications which are energy conserving, environmentally sound, small scale and low cost; and

(e) Applications which demonstrate simplicity of installation, operation and maintenance.

§ 470.11 Eligibility requirements.

(a) Support under this part may be made to individuals, local non-profit organizations and institutions. State and local agencies, Indian tribes and small businesses.

(b) The aggregate amount of support made available to any participant in the program, including affiliates, shall not exceed $50,000 during any 2-year period. This limitation applies only to support for projects and not to funds received by participants from DOE for other purposes, such as performance of services.

(c) Projects which shall be considered for support are those which carry out the purposes of the program as expressed in § 470.10 and which are within the following categories—

(1) Idea development, i.e., the development of an idea or concept or an investigative finding in areas ranging from development of new concepts of energy sources to the utilization of old procedures or systems for a new application;

(2) Device development, i.e., the systematic use and practical application of investigative findings and theories of a scientific or technical nature toward the production of, or improvements in, useful products to meet specific performance requirements but exclusive of manufacturing and production engineering. The dominant characteristic is that the effort be pointed toward specific energy problem areas to develop and evaluate the feasibility and practicability of proposed solutions and determine their parameters. Device development includes studies, investigations, initial hardware development and ultimately development of hardware, systems, or other means for experimental or operational test; or

(3) Demonstration, i.e., the testing of a system or technique under operation conditions to show that commercial application is technically, economically and environmentally feasible.

(d) Support for each category in paragraph (c) of this section shall not, for a single participant in the program, including affiliates, exceed the following limits for any project—

(1) For idea development, $10,000;

(2) For device development, $50,000; and

(3) For demonstration, $50,000.

(4) A participant may receive under a subsequent program solicitation—

(i) Additional support for a funded project or;

(ii) Initial support for a new project, subject to the support limits set forth in paragraphs (b) and (d) of this section.

§ 470.12 Management.

(a) The program shall be managed by a National Program Director within the Office of the Assistant Secretary for Conservation and Solar Energy of DOE.

(b) The program shall be implemented regionally, based on the 10 standard Federal regions or combinations thereof, to insure substantial consideration of the needs, resources, and special circumstances of local communities. Regions may be combined provided the requirements of Office of Management and Budget Circular A-106 entitled "Standard Federal Regulations" are met. Regional Program Managers shall design and manage the regional programs as directed by the National Program Director and shall consult, as appropriate, with State and local officials, the appropriate technology community and other interested parties.

§ 470.13 Program solicitation.

(a) The Regional Program Managers shall be responsible for the preparation of program solicitations which solicit proposals for support under the program pursuant to simplified application procedures. Projects may be supported under the program only if they have successfully completed under a program solicitation.

(b) Each program solicitation shall include—

(1) A description of the program;

(2) The eligibility requirements;

(3) A time schedule for submission of, and action on, proposals;

(4) A simple application form for submitting a proposal for support under the program, together with instructions for completing the application form;

(5) Evaluation criteria, along with a narrative description of their relative importance;

(6) An explanation of the evaluation and selection procedures, including a notice to proposers that if the proposer expressly indicates that only Government evaluation is authorized, DOE may be unable to give full consideration to the proposal.

(7) Other applicable information, terms and conditions, including the desired budget format;

(8) Place for, and manner of, submission;

(9) A unique number for identification purposes;

(10) A statement notifying potential proposers that an announcement does not commit DOE to pay any proposal perparation costs and that DOE reserves the right to select for support any, all, or none of the proposals received in response to a solicitation;

(11) A late proposal provision;

(12) A statement notifying proposers how to identify information in the proposal which the proposer does not want disclosed for purposes other than the evaluation of the proposal.

(13) A statement notifying proposers that all information contained in the proposal will be handled in accordance with the policies and procedures set forth in DOE-AR and DOE-PR, as applicable, and disclosed, if appropriate, in accordance with 10 CFR Part 1004 entitled "Freedom of Information."

(14) A statement notifying proposers of their right to request a debriefing pursuant to the procedures set forth in § 470.18; and

(15) A statement notifying proposers of their right to request a waiver of DOE's title to inventions made under the program.

(c) Each program solicitation shall be synopsized in the *Commerce Business Daily* prior to or concurrent with release. The program solicitation also shall be announced to appropriate newspapers, trade and technical publications, and State and local governments, and shall be circulated directly to interested individuals, entities, and associations thereof, to the maximum extent feasible.

§ 470.14 Evaluation and selection.

(a) Prior to making a comprehensive evaluation of a proposal, the receiving office shall determine that it contains sufficient technical, cost, and other information to enable comprehensive evaluation and that it has been properly signed. If the proposal does not meet these requirements, a prompt reply shall be sent to the proposer, indicating the reason(s) for the proposal not being selected for support under the program solicitation. A proposer may correct any minor informality or irregularity or apparent clerical mistake prior to the entering into of grants, contracts, or cooperative agreements. A minor informality or irregularity is one which is merely a matter of form and not of substance or pertains to some immaterial or inconsequential defect or variation from the exact requirements of the program announcement.

(b)(1) The Regional Program Manager shall select a number of technical evaluation reviewers representing several disciplines to ensure adequate technical review of proposals.

(2) After receiving nominations from each State or combinations of States within the Region, the Program Manager shall select a number of State reviewers for each State or combinations of States, respectively. The nominations and selections of State reviewers shall take into consideration representation by persons from a variety of

backgrounds, in order that the reviewers are able to evaluate proposals of potential merit in various fields and from various types of proposers.

(3) The Regional Program Manager or designee shall provide proposals to the technical evaluation and State reviewers and shall provide their findings and comments to the selection panel established pursuant to paragraph (3) of this section.

(4) In carrying out the responsibilities set forth in paragraphs (b) (1), (2) and (3) of this section, the Regional Program Manager (i) shall determine the number of technical evaluation and State reviewers who shall review each proposal; (ii) shall determine the sequence of the technical and State review; (iii) may designate a person to serve as both a technical and State reviewer, if appropriate to the needs of the program in the Region. A decription of the Program Manager's determinations under this paragraph shall be included in the Program Solicitation pursuant to § 470.13(b)(6).

(c) Each technical evaluation reviewer shall evaluate those proposals which he or she receives from the Regional Program Manager or designee and shall provide his or her findings to the Regional Program Manager or designee. In addition to the general criteria underlying the establishment of the program as set forth in § 470.10, the major criteria to be considered by each technical evaluation reviewer shall include—

(1) Whether the proposal is technically feasible, including a determination as to whether the proposed energy savings or energy production can be technically achieved;

(2) Whether the results being proposed are capable of being measured;

(3) Whether the proposal has any potential environmental, health and safety impacts; and

(4) From a technical standpoint, whether the proposal can be carried out within the funds being requested.

(d) Each State reviewer shall evaluate those proposals which he or she receives from the Program Manager or designee and shall provide his or her findings and comments to the Program Manager or designee. In addition to the general criteria underlying establishment of the program as set forth in § 470.10, the criteria to be considered by each State reviewer shall include—

(1) The potential impact of the proposal on the energy needs and requirements of the community or region;

(2) The energy resource involved and its importance or availability to the community or region;

(3) The expected energy savings or production that will result from the proposal and the significance of those savings or production to the energy requirements of the community or region;

(4) The institutional barriers that may substantially affect the proposal and the potential of the proposal to deal with those barriers;

(5) The likelihood of commercialization or utilization of the technology, process, or items within the proposal and extent of such commercialization/utilization;

(6) The innovative nature of the proposal;

(7) Any potential environmental, health and safety impacts of the proposal upon the community or region;

(8) The extent to which work beyond the funded project period might be required;

(9) The extent to which local resources, material, and manpower will be utilized; and

(10) The adequacy of the business aspects of the proposal, including the reasonableness of the proposer's budget for carrying out the proposal.

(e) A selection panel composed of DOE personnel appointed by the Regional Program Manager shall, taking into account the findings and comments of the technical evaluation and State reviewers, evaluate and rank the proposals in accordance with the criteria stated in the program solicitation.

(f) For each Region, a DOE selection official shall select proposals for support from the ranking established by the selection panel, taking into account the following program policy factors in order to determine the mix of proposed projects which will best further specific program goals—

(1) Regional distribution, including geography, population, and climate;

(2) Project type distribution, including a diversity of methods, approaches, and technologies;

(3) Diversity of participants; and

(4) The best overall use of the funds available.

§ 470.15 Allocation of funds.

(a) DOE shall annually allocate fiscal year funds available for support among the 10 standard Federal Regions, according to the following formula;

(1) Two-thirds to be allocated according to population; and

(2) One-third to be allocated according to the number of proposals received, per hundred thousand of population of the Region, which meet the requirements set forth in § 470.14(a).

(b) The minimum annual level of support for projects for each State within a Region shall be 10 percent of the fiscal year funds allocated to the Region, divided by the number of States in the Region.

(c) For the purposes of this section, population shall be determined by the most current complete national series, as published by the United States Bureau of the Census in *Current Population Reports*, P-25, P-26, or related series, except where data from the decennial census conducted by the Bureau of the Census is more current.

§ 470.16 Cost sharing and funds from other sources.

Proposers are encouraged to offer to share in the costs of their proposed projects or to arrange that other entities provide cost sharing on their behalf. Regional Program Managers, with the consent of the proposer, may work with States, local governments or other entities to obtain supplemental funding.

§ 470.17 General requirements.

(a) Except where this part provides otherwise, the submission, evaluation and selection for support of proposals under the program and the entering into and administration of grants, cooperative agreements, and contracts under the program, shall be governed by the provisions of DOE-AR and DOE-PR are applicable, such other procedures applicable to grants, cooperative agreements, and contracts under the program as DOE may from time to time prescribe, and any Federal requirements applicable to grants, cooperative agreements, and contracts under the program.

(b) Each grant, cooperative agreement or contract under this part shall require that a recipient of support under the program shall submit a full written report of activities supported in whole or in part by Federal funds made available under the program and shall contain any additional report provisions and other provisions dealing with records, allowable expenses, accounting practices, publication and publicity, copyrights, patents, discrimination, conflict of interest, insurance, safety, changes, resolution of disputes and other standard and/or relevant support agreements requirements required by, or appropriate to, the needs of the program.

§ 470.18 Debriefing.

Upon written request, unsuccessful proposers will be accorded debriefings. Such debriefings must be requested within 30 working days of notification of elimination from consideration. Debriefings will be provided at the earliest feasible time as determined by the Regional Program Manager.

§ 470.20 Dissemination of Information.

DOE shall disseminate to the public, in an appropriate manner, information of the nature, usage and availability of the energy-related systems and supporting technologies developed or demonstrated under the program. In addition, DOE shall maintain and make available to recipients of support under the program current information on public and private sources of possible assistance for the further development and commercialization of their projects.

PART 473—AUTOMOTIVE PROPULSION RESEARCH AND DEVELOPMENT

Review and Certification of Grants, Cooperative Agreements, Contracts, and Projects

Sec.
473.1 Purpose and scope.
473.2 Definitions.
473.10 Required information from applicant.
473.11 Submission of applicant's information.
473.20 Public notice and opportunity to object.
473.21 Supplemental information and rebuttal.
473.22 Initial review by manager.
473.23 Interagency review panel.
473.24 Final action and certification by manager.
473.25 Reviewability of certification.
473.30 Standards and criteria.

Authority: Federal Energy Administration Act of 1978—Civilian Applications, Pub. L. 95-238; Department of Energy Organization Act, Pub. L. 95-91.

Source: 43 FR 55230, Nov. 24, 1978, unless otherwise noted.

Review and Certification of Grants, Cooperative Agreements, Contracts, and Projects

§ 473.1 Purpose and scope.

These regulations implement section 304(f) of the Federal Energy Administration Act of 1978—Civilian Applications, and apply to each new contract, grant, cooperative agreement, Department of Energy project, or other agency project funded or to be funded under the authority of that Act. 15 U.S.C. 2703(f) (1970). These regulations do not apply to subcontractors, or to contracts, grants, cooperative agreements, Department of Energy projects, or other agency projects entered into, made, or formally approved and initiated prior to February 25, 1978, or with respect to any renewal or extension thereof. Insofar as grants, cooperative agreements, and contracts are concerned, these regulations provide procedures and requirements that are in addition to those generally applicable under the assistance and procurement regulations of the Federal agency funding research and development under the Act.

§ 473.2 Definitions.

For purpose of these regulations—

“Act” means the Federal Energy Administration Act of 1978—Civilian Applications. Pub. L. 95-238, 92 Stat. 47.

“Advanced automobile propulsion system” means an energy conversion system, including engine and drivetrain, which utilizes advanced technology and is suitable for use in an advanced automobile.

“Agency project” means research and development under the Act by employees of a Federal agency furnishing assistance at the request of the DOE.

“Annual funding period” means the Federal fiscal year during which a grant, cooperative agreement, or contract is funded by an appropriation under the Act.

“Applicant” means any private laboratory, university, nonprofit organization, industrial organization, private agency, institution, organization, corporation, partnership, individual, or public agency other than a Federal agency.

“DOE project” means research and development under the Act by employees of the DOE.

“Federal agency” means an executive agency as defined by 5 U.S.C. 105 (1970).

“Manager” means the Federal program official who requests grant agreements, cooperative agreements, or contracts to be negotiated or who authorizes a DOE or agency project to begin.

“Notice of availability” means a notice published in the Commerce Business Daily advertising the availability of a formal solicitation document to be issued for the purpose of inviting and setting guidelines for submission of proposals for research and development grants, cooperative agreements, or contracts.

“Research and development” means activities constituting a project to create an advanced automobile propulsion system and does not mean activities involving technology transfer to mass production, evaluative testing, preliminary planning for a DOE or an ency project, or program adminis- tion and managment.

"Solicitation" means a formal, writ- n request for proposals to perform earch and development under a ant, cooperative agreement, or con- ct, typically including evaluation teria and a statement of the work to done.

73.10 Required information from applicant.

n accordance with applicable proce- res of § 473.11 any applicant for a ant, cooperative agreement, or con- ct under the Act to support re- arch and development activities of advanced automobile propulsion stem shall—

(a) State whether the activities will itiate or continue research and de- elopment of an advanced automobile opulsion system;

(b) State, insofar as the applicant s information, whether and to what tent the activities to be supported e technically the same as activities nducted previously or to be conduct- d during the annual funding period y any person for research and devel- pment of a substantially similar ad- nced automobile propulsion system;

(c) Justify research and development ctivities on an advanced automobile ropulsion system abandoned by any erson because of a lack of mass pro- duction potential by presenting infor- mation showing a significant interven- ng technological advance, promising conceptual innovation, or other special onsideration;

(d) Provide—

(1) An assurance that the amount of funds to be expended for research and development of advanced automobile propulsion systems during the initial annual funding period will exceed the amount of funds expended, if any, during the previous year for the same purpose by at least the amount of the rant, cooperative agreement, or contract being sought; and

(2) An assurance that the level of re- earch and development effort on advanced automobile propulsion systems in the initial annual funding period will not be decreased in future annual funding periods.

(e) Provide to the extent possible—

(1) An assurance that the time period for completing research and development of the advanced automobile propulsion is likely to be shorter as a result of a grant, cooperative agreement, or contract; and

(2) The estimated delay, if any, which is likely to occur if the application for a grant, cooperative agreement, or contract is denied.

§ 473.11 Submission of applicant's information.

(a) An applicant submitting an unsolicited proposal to conduct research and development to be funded by a grant, cooperative agreement, or contract under the Act shall include the information required under § 473.10 in the unsolicited proposal document filed under the assistance or procurement regulations of the DOE or other Federal agency which funds the proposed research and development under the Act.

(b) In responding to a solicitation for a proposal to conduct research and development funded by a grant, cooperative agreement, or contract under the Act, the applicant shall include the information required under § 473.10 in the proposal.

(c) Information submitted under § 473.10 of these regulations shall be certified in writing as complete and accurate by the applicant, and if the applicant is not an individual, the chief executive officer of the applicant or his authorized designee shall sign the certification.

§ 473.20 Public notice and opportunity to object.

(a) In compliance with paragraph (b) of this section and unless provisions of paragraph (c) of this section apply, the manager shall cause to be published in the Commerce Business Daily a statement describing the unsolicited proposal, solicitation, DOE project, or agency project, as appropriate, inviting any interested person to submit a written objection, with supporting information at an appropriate address on or before 30 days from the date of publication, if the person believes that the research and development to be performed does not comply with standards and criteria of § 473.30.

(b) Except as paragraph (c) of this section applies, the manager shall comply with the requirements of paragraph (a) of this section—

(1) Upon receipt of an unsolicited proposal from an applicant;

(2) In any notice of availability of a solicitation;

(3) Prior to beginning a DOE project; or

(4) Prior to beginning an agency project.

(c) Without publishing a notice under paragraph (a) of this section, the manager may reject an unsolicited proposal that does not comply with these regulations or any other generally applicable requirements.

§ 473.21 Supplemental information and rebuttal.

The manager may request additional information from an applicant or any interested person who files an objection under § 473.20.

§ 473.22 Initial review by manager.

(a) Upon expiration of the time for filing information under these regulations, the manager shall—

(1) Review the proposed research and development to be performed under grant, under cooperative agreement, under contract, as a DOE project, or as an agency project and any other pertinent information received under these regulations or otherwise available; and

(2) Initially determine whether the research and development reviewed under paragraph (a)(1) of this section complies with the standards and criteria of § 473.30.

(b) A manager who makes a negative determination under paragraph (a)(2) of this section shall inform the applicant and any interested person who objected of the decision in writing with a brief statement of supporting reasons.

(c) A manager who initially determines that research and development reviewed under this section complies with the standards and criteria of § 473.30 shall cause an interagency review panel to be convened under § 473.23.

§ 473.23 Interagency review panel.

(a) The interagency review panel shall consist of—

(1) A head designated by the Federal agency that employs the manager;

(2) A representative of the DOE if the manager is not an employee of the DOE; and

(3) A representative of any other Federal agency deemed appropriate by the Federal agency that employs the manager.

(b) The interagency review panel shall—

(1) Review the research and development to be performed and consider the information presented by the applicant, in the case of a grant, cooperative agreement, or contract, and by any interested person who filed a statement of objection;

(2) Make a recommendation with a supporting statement of findings to the manager as to whether the research and development to be performed complies with the standards and criteria of § 473.30; and

(3) Operate by majority vote with the head of the panel casting the decisive vote in the event of a tie.

§ 473.24 Final action and certification by manager.

(a) Upon consideration of the recommendation of the interagency review panel and other pertinent information, the manager—

(1) Shall determine whether the research and development to be performed complies with the standards and criteria of § 473.30;

(2) Shall obtain the concurrence of the DOE if the manager is not an employee of the DOE;

(3) Shall, in the event of a negative determination under this section, advise the applicant, in the case of a grant, cooperative agreement, or contract, and any interested person who filed a statement of objection; and

(4) Shall, in the event of an affirmative determination under this section, prepare a certification—

(i) Explaining the determination;

(ii) Discussing any allegedly related or comparable industrial research and development considered and deemed be an inadequate basis for not certifying the grant or contract;

(iii) Discussing issues regarding cost sharing and patent rights related to the standards and criteria of § 473.30 of these regulations; and

(iv) Discussing any other relevant issue.

(b) After complying with paragraph (a) of this section, the manager shall sign the certification and distribute copies to the applicant, if any, and any interested person who filed a statement of objections—

(1) Immediately in the case of a DOE or agency project; and

(2) After the agreement has been negotiated in the case of a grant, cooperative agreement, or contract.

§ 473.25 Reviewability of certification.

Any certification issued under these rules is—

(a) Subject to disclosure under 5 U.S.C. 552 (1970) and section 17 of the Federal Nonnuclear Energy Research and Development Act of 1974, as amended, 42 U.S.C. 5918 (1970);

(b) Subject neither to judicial review nor to the provisions of 5 U.S.C. 551-559 (1970), except as provided under paragraph (a) of this section; and

(c) Available to the Committee on Science and Technology of the House of Representatives and the Committee on Energy and Natural Resources of the Senate.

§ 473.30 Standards and criteria.

Research and development to be performed under a grant, under a cooperative agreement, under a contract, as a DOE project, or as an agency project under the Act may be certified under these regulations only if the research and development to be conducted—

(a) Supplements the automotive propulsion system research and development efforts of industry or any other private researcher;

(b) Is not duplicative of efforts previously abandoned by private researchers unless there has been an intervening technological advance, promising conceptual innovation, or justified by other special consideration;

(c) Would not be performed during the annual funding period but for the availability of the Federal funding being sought;

(d) Is likely to produce an advanced automobile propulsion system suitable for steps toward technology transfer to mass production in a shorter time period than would otherwise occur;

(e) Is not technologically the same as efforts by any person conducted previously or to be conducted during the annual funding period regarding a substantially similar advanced automobile propulsion system; and

(f) Is not likely to result in a decrease in the level of private resources expended on advanced automotive research and development by substituting Federal funds without justification.

PART 474—ELECTRIC AND HYBRID VEHICLE RESEARCH, DEVELOPMENT AND DEMONSTRATION PROGRAM; EQUIVALENT PETROLEUM-BASED FUEL ECONOMY CALCULATION

Sec.
474.1 Purpose and scope.
474.2 Definitions.
474.3 Test procedures.
474.4 Equivalent petroleum-based fuel economy calculation.

AUTHORITY: Sec. 503(a)(3), Motor Vehicle Information and Cost Savings Act, Pub. L. 94-163 (15 U.S.C. 2003(a)(3)), as added by sec. 18, Chrysler Corporation Loan Guarantee Act of 1979, Pub. L. 96-185; Department of Energy Organization Act, Pub. L. 95-91.

SOURCE: 46 FR 22753, Apr. 21, 1981, unless otherwise noted.

§ 474.1 Purpose and scope.

This part contains procedures for calculating the equivalent petroleum-based fuel economy value of electric vehicles, as required to be prescribed by the Secretary of Energy under section 503(a)(3) of the Motor Vehicle Information and Cost Savings Act (15 U.S.C. 2003(a)(3)), as added by section 18 of the Chrysler Corporation Loan Guarantee Act of 1979. The equivalent petroleum-based fuel economy value is intended to be used in calculating corporate average fuel economy pursuant to regulations promulgated by the Environmental Protection Agency at 40

CFR Part 600—Fuel Economy of Motor Vehicles.

§ 474.2 Definitions.

For purposes of this part, the term—

"Electric vehicle" means a vehicle that is powered by an electric motor drawing current from rechargeable storage batteries or other portable energy storage devices. Recharge energy shall be drawn primarily from a source off the vehicle, such as residential electric service.

"Electrical efficiency value" means the weighted average of the stop-and-go and steady-speed electrical efficiency values, as determined in accordance with § 474.4(b).

"Energy equivalent fuel economy value" means the electrical efficiency value converted into units of miles per gallon, as determined in accordance with § 474.4(c).

"Equivalent petroleum-based fuel economy value" means a number, determined in accordance with § 474.4, which represents the average number of miles travelled by an electric vehicle per gallon of gasoline.

"Model type" means the term defined by the Environmental Protection Agency in its regulations at 40 CFR 600.002-81(19).

"Model year" means the term defined by the Environmental Protection Agency in its regulations at 40 CFR 600.002-81(6).

"Petroleum equivalency factor" means a number which represents the parameters listed in section 503(a)(3)(ii) through (iv) of the Motor Vehicle Information and Cost Savings Act (15 U.S.C. 2003(a)(3)) for purposes of calculating equivalent petroleum-based fuel economy in accordance with § 474.4.

"Petroleum-powered accessory" means a heater/defroster system or an air conditioner system which uses fuel, as defined in section 501(5) of the Motor Vehicle Information and Cost Savings Act (15 U.S.C. 2001) as its primary energy source.

"Production volume" means the term defined by the Environmental Protection Agency in its regulations at 40 CFR 600.002-81(32).

"Steady-speed electrical efficiency value" means the average number of kilowatt-hours of electrical energy required for an electric vehicle to travel 1 mile, as determined in accordance with § 474.3(c).

"Stop-and-go electrical efficiency value" means the average number of kilowatt-hours of electrical energy required for an electric vehicle to travel 1 mile, as determined in accordance with § 474.3(b).

[46 FR 22753, Apr. 21, 1981, as amended at 48 FR 28432, June 22, 1983]

§ 474.3 Test procedures.

(a) The conditions and equipment in the Electric Vehicle Test Procedure—SAE J227a of the Society of Automotive Engineers shall be used for conducting the test procedures set forth in this section.

(b) The test procedures prescribed in SAE procedure J227a, Vehicle Energy Economy, using Vehicle Test Cycle C for the driving cycle, shall be used for generation of the stop-and-go electrical efficiency value.

(c) The test procedures prescribed in SAE procedure J227a, Vehicle Energy Economy, using a driving cycle consisting of a maximum cruise speed of 54 mph, as prescribed in the SAE procedure for Range at Steady Speed, shall be used for generation of the steady-speed electrical value. For an electric vehicle model type that is incapable of maintaining a maximum cruise speed of 54 mph, this test procedure shall be conducted at the maximum cruise speed as defined in section 2.8 of the SAE procedure J227a.

§ 474.4 Equivalent petroleum-based fuel economy calculation.

(a) Calculate the equivalent petroleum-based fuel economy of an electric vehicle as follows:

(1) Determine the stop-and-go electrical efficiency value, according to § 474.3(b).

(2) Determine the steady-speed electrical efficiency value, according to § 474.3(c).

(b) Calculate the electrical efficiency value by:

(1) Multiplying the stop-and-go electrical efficiency value by 0.91;

(2) Multiplying the steady-speed electrical efficiency value by 0.09; and

(3) Adding the resulting two figures, rounding to the nearest 0.01 kWh/mile.

(c) Calculate the energy equivalent fuel economy value by dividing the electrical efficiency value into 36.66.

(d) For purposes of paragraph (e) of this section, use the appropriate Petroleum Equivalency Factor as follows:

(1) If no more than 33 percent of the production volume of the electric vehicle model type is to be equipped with any petroleum-powered accessories, use the first number listed under paragraph (e) of this section for the applicable model year.

(2) If more than 33 percent of the production volume of the electric vehicle model type is to be equipped with only one petroleum-powered accessory, use the second number under paragraph (e) of this section of the applicable model year.

(3) If more than 33 percent of the production volume of the electric vehicle model type is to be equipped with two petroleum-powered accessories, use the third number under § 474.4(e) for the applicable model year.

(e) Calculate the equivalent petroleum-based fuel economy value in miles per gallon by multiplying the energy equivalent fuel economy value by the appropriate petroleum equivalency factor for the model year in which the electric vehicle is manufactured.

(1) For model year 1981, the petroleum equivalency factor is:

(i) 1.9,

(ii) 1.7, or

(iii) 1.6;

(2) For model year 1982, the petroleum equivalency factor is:

(i) 2.0,

(ii) 1.8, or

(iii) 1.6;

(3) For model year 1983, the petroleum equivalency factor is:

(i) 2.0,

(ii) 1.8, or

(iii) 1.6;

(4) For model year 1984, the petroleum equivalency factor is:

(i) 2.1,

(ii) 1.9, or

(iii) 1.7;

(5) For model year 1985, the petroleum equivalency factor is:

(i) 2.3,

(ii) 2.0, or

(iii) 1.8;

(6) For model year 1986, the petroleum equivalency factor is:

(i) 2.2,

(ii) 2.0, or

(iii) 1.8; and

(7) For model year 1987, the petroleum equivalency factor is:

(i) 2.2,

(ii) 2.0, or

(iii) 1.8.

PART 475—ELECTRIC AND HYBRID VEHICLE RESEARCH, DEVELOPMENT, AND DEMONSTRATION PROJECT

Subpart A—General Provisions

Sec.
475.1 Purpose and scope
475.2 Definitions.
475.3 Test conditions and procedures.
475.4 Units.

Subpart B—Minimum Levels of Performance

475.10 Minimum levels of performance for personal-use vehicles.
475.11 Minimum levels of performance for commercial vehicles.

Authority: Electric and Hybrid Vehicle Research, Development, and Demonstration Act of 1976, Pub. L. 94-413, as amended by Department of Energy Act of 1978—Civilian Applications, Pub. L. 95-238; Energy Reorganization Act of 1974, Pub. L. 93-438; Department of Energy Organization Act, Pub. L. 95-91.

Source: 45 FR 9544, Feb. 12, 1980, unless otherwise noted.

Subpart A—General Provisions

§ 475.1 Purpose and scope.

This part contains performance standards for electric and hybrid vehicles required to be prescribed by the Department of Energy pursuant to section 7(b)(1) of the Act.

§ 475.2 Definitions.

As used in this part:

"Act" means the Electric and Hybrid Vehicle Research, Development, and Demonstration Act of 1976 (Pub. L. 94-413, 90 Stat. 1263 et seq.), as amended by Department of Energy

Act of 1978—Civilian Applications (Pub. L. 95-238; 92 Stat. 47, 91-94).

"Commercial vehicle" means a vehicle other than a personal-use vehicle.

"Electric vehicle" means a vehicle which is powered by an electric motor drawing current from rechargeable storage batteries, fuel cells, or other portable sources of electrical current, and which may include a nonelectrical source of power designed to charge batteries and components thereof.

"Hybrid vehicle" means a vehicle propelled by a combination of an electric motor and an internal combustion engine or other power source and components thereof.

"Personal-use vehicle" means a vehicle designed to carry ten persons or less, except a multipurpose passenger vehicle, motorcycle, truck, or trailer, as those terms are defined in 49 CFR 571.3.

"Vehicle" means an electric or hybid vehicle.

"Vital accessories" means headlights, taillights, windshield wipers, windshield defroster and defroster blowers. The heater blowers also shall be considered as vital accessories if the vehicle is equipped with a heater.

§ 475.3 Test conditions and procedures.

The conditions and procedures in Electric Vehicle Test Procedure—SAE J227a, as revised February 1976, of the Society of Automotive Engineers, shall be used to determine the levels of performance of vehicles for those categories for which minimum levels of performance are prescribed in Subpart B.

§ 475.4 Units.

The units and unit symbols and abbreviations used in this part are those of the International System of Units (Systeme International) or SI as established by the General Conference of Weights and Measures in 1960 and interpreted and modified for the United States pursuant to the U.S. Department of Commerce Notice on the Interpretation and Modification of the International System of Units for the United States (41 FR 54018, Dec. 10, 1976).

Subpart B—Minimum Levels of Performance

§ 475.10 Minimum levels of performance for personal-use vehicles.

The following minimum levels of performance are required with respect to any personal-use vehicle purchased or leased in fulfillment of contracts entered into following the effective date of these regulations, pursuant to section 7(c) of the Act.

(a) *Acceleration.* The time required to accelerate from rest to 50 km/h shall not exceed 13.5s.

(b) *Gradeability at speed.* The grade which can be traversed up at 25 km/h shall be at least 10 percent.

(c) *Gradeability limit.* The grade on which the vehicle can start and climb for 20s either backward or forward shall be no less than 20 percent.

(d) *Forward speed capability.* The speed which can be maintained for 5 minutes shall be 80 km/h.

(e) *Range.* The distance which the vehicle can be operated with vital accessories on or equivalent, shall be:

(1) For an electric vehicle, at least 55 km on the SAE J227 a/C cycle, and

(2) For a hybrid vehicle, at least 200 km on the SAE J227 a/C cycle.

(f) *Battery recharge time.* The vehicle shall be capable of satisfying the range requirement of paragraph (e) of this section, after being recharged for no more than 10 hours by use of an on-board charger. At the start of this recharge the vehicle shall have 80 percent discharged batteries as specified by the vehicle test conditions and procedures of § 475.3. The on-board charger shall be compatible with an electric power outlet of 110V or 220V AC, as specified by the vehicle manufacturer.

(g) *Recharge control.* The vehicle shall have an automatic recharge control which will meet the requirements of energy, life, and safety as such requirements are stated by these performance standards. This paragraph applies when on-board chargers are used and also when off-board chargers supplied by or specified by the vehicle manufacturer for recharge of the vehicle are used.

(h) *Energy consumption.* (1) For an electric vehicle, the maximum amount of nonelectrical energy consumed shall be that used for operation of the accessories only.

(2) For a hybrid vehicle, nonelectrical energy consumed shall not exceed 1.3 MJ/km and shall also not exceed 75 percent of total energy consumed for propulsion and vital accessories, based on being fully loaded on a driving schedule of 33 km on SAE J227 a/C cycle plus 33 km at 75 km/h (higher heating value of gasoline taken as 32.7 MJ/L) and with vital accessories on.

(i) *Battery life.* (1) The vehicle shall be capable of at least 75 percent of the range specified in § 475.10(e) after 12 months or 15,000 km of normal use, whichever occurs first.

(2) The vehicle shall be capable of 100 percent of the acceleration and gradeability specified in § 475.10 (a), (b), and (c), for all test conditions and procedures specified by § 475.3, for 12 months or 15,000 km or normal use, whichever occurs first.

(3) The batteries shall, if necessary, be repaired or replaced by the vehicle manufacturer at no cost to the user of the vehicle in order to meet requirements of § 475.10(i) (1) and (2).

(j) *State-of-charge meter.* The vehicle shall have a state-of-charge meter for the propulsion battery system or other means of providing an indication of remaining range.

(k) *Odometer.* The vehicle shall have an odometer.

(l) *Passenger comfort heater.* The vehicle shall have the capability of having a passenger comfort heater installed at the option of the purchaser.

(m) *Documentation.* Adequate user manuals, maintenance (service) manual and parts lists shall be provided.

(n) *Emissions.* The vehicle shall comply with all applicable Federal emissions regulations for motor vehicles.

(o) *Safety, crashworthiness, damageability, crash avoidance and hazards.* (1) The vehicle shall comply with all applicable Federal motor vehicle safety standards as set forth in 49 CFR Part 571, unless a temporary exemption is obtained by the manufacturer from the Department of Transportation.

(2) Until the Department of Transportation issues regulations which cover the same subjects, the vehicle shall also have the following performance characteristics:

(i) The electric propulsion circuit shall be electrically isolated from other conductive portions of the vehicle sufficiently to prevent personal hazards due to contacting any portion of the electric propulsion circuit while in contact with other portions of the vehicle.

(ii) The vehicle shall be capable of complying with the performance requirements of Federal motor vehicle safety standards 208 and 301 with all battery materials remaining outside the passenger compartment.

(iii) Vehicles with battery vents shall have flame barrier provisions to inhibit battery explosions.

(iv) Ventilation shall be adequate within the battery compartment to maintain the concentration of hydrogen below 4 percent by volume during vehicle operation (including charging and maintenance).

(v) The vehicle shall have a device which provides for the positive disconnection of the battery and which is operable from the normal operator position.

(vi) The vehicle shall be capable of being parked for up to 8 hours in temperatures of −25° C. to 50° C. and subsequently operated, by moving forward under its own power, at any temperature within this temperature range without damage to the vehicle or hazard to persons.

§ 475.11 Minimum levels of performance for commercial vehicles.

The following minimum levels of performance are required with respect to any commercial vehicles purchased or leased in fulfillment of contracts entered into following the effective date of these regulations, pursuant to section 7(c) of the Act.

(a) *Acceleration.* The time required to accelerate from rest to 50 km/h shall not exceed 14s for vehicles with a payload carrying capability of less than or equal to 600 kg.

(b) *Gradeability at speed.* The grade which can be traversed up at 25 km/h shall be at least 10 percent.

(c) *Gradeability limit.* The grade which the vehicle can start and climb for 20s either backward or forward shall be no less than 20 percent.

(d) *Forward speed capability.* The speed which can be maintained for 5 minutes shall be 75 km/h.

(e) *Range.* The distance which the vehicle can be operated with vital accessories on or equivalent shall be:

(1) For an electric vehicle, at least 60 km on the SAE J227 a/B cycle, and

(2) For a hybrid vehicle, at least 200 km on the SAE J277 a/B cycle.

(f) *Battery recharge time.* The vehicle shall be capable of satisfying the range requirement of § 475.11(e) above, after being recharged for no more than 10 hours. At the start of this recharge, the vehicle shall have 80 percent discharged batteries as specified by the vehicle test conditions and procedures of § 475.3.

(g) *Recharge control.* The vehicle shall have an automatic recharge control which will meet the requirements of energy, life, and safety as such requirements are stated by these performance standards. This paragraph applies when on-board chargers are used and also when offboard chargers supplied by or specified by the vehicle manufacturer for recharge of the vehicle are used.

(h) *Energy Consumption.* (1) For an electric vehicle, the maximum amount of nonelectrical energy consumed shall be that used for operation of the accessories only.

(2) For a hybrid vehicle, nonelectrical energy consumed shall not exceed 9.8 kJ/kmkg of cargo and shall also not exceed 75 percent of total energy consumed for propulsion and vital accessories, based on being fully loaded on a driving schedule of 100 km on SAE J227 a/B cycle, the cargo not including the operator, and with vital accessories on.

(i) *Battery life.* (1) The vehicle shall be capable of at least 75 percent of the range specified in § 475.11(e) after 12 months or 15,000 km of normal use, whichever occurs first.

(2) The vehicle shall be capable of 100 percent of the acceleration and gradeability specified in paragraph (a), (b), and (c) of this section, for all test conditions and procedures specified by § 475.3 for 12 months or 15,000 km or normal use, whichever occurs first.

(3) The batteries shall, if necessary, be repaired or replaced by the vehicle manufacturer at no cost to the user of the vehicle in order to meet requirements of paragraphs (i) (1) and (2) of this section.

(j) *State-of-charge meter.* The vehicle shall have a state-of-charge meter for the propulsion battery system or other means of providing an indication of remaining range.

(k) *Odometer.* The vehicle shall have an odometer.

(l) *Passenger comfort heater.* The vehicle shall have the capability of having a passenger comfort heater installed at the option of the purchaser.

(m) *Documentation.* Adequate user manuals, maintenance (service) manuals and parts lists shall be provided.

(n) *Emissions.* The vehicle shall comply with all applicable Federal emissions regulations for motor vehicles.

(o) *Safety, crashworthiness, dامageability, crash avoidance and hazards.* (1) The vehicle shall comply with all applicable Federal motor vehicle safety standards as set forth in 49 CFR Part 571, unless a temporary exemption is obtained by the manufacturer from the Department of Transportation.

(2) Until the Department of Transportation issues regulations which cover the same subjects, the vehicle shall also have the following performance characteristics:

(i) The electric propulsion circuit shall be electrically isolated from other conductive portions of the vehicle sufficiently to prevent personal hazards due to contacting any portion of the electric propulsion circuit while in contact with other portions of the vehicle.

(ii) The vehicle shall be capable of complying with ther performance requirements of Federal motor vehicle safety standards 208 and 301 with all battery materials remaining outside the passenger compartment.

(iii) Vehicles with battery vents shall have flame barrier provisions to inhibit battery explosions.

(iv) Ventilation shall be adequate within the battery compartment to maintain the concentration of hydrogen below 4 percent by volume during vehicle operation (including charging and maintenance).

(v) The vehicle shall have a device which provides for the positive disconnection of the battery and which is operable from the normal operator position.

(vi) The vehicle shall be capable of being parked for up to 8 hours in temperatures of −25° C. to 50° C. and subsequently operated, by moving forward under its own power, at any temperature within this temperature range without damage to the vehicle or hazard to persons.

PART 476—ELECTRIC AND HYBRID VEHICLE RESEARCH, DEVELOPMENT, AND DEMONSTRATION PROGRAM SMALL BUSINESS PLANNING GRANTS

Sec.

476.1 Purpose and scope.
476.2 Definitions.
476.3 General requirements.
476.4 Eligibility requirements.
476.5 Program solicitation.
476.6 Evaluation and selection.
476.7 Allowable expenditures.
476.8 Contract proposals.

AUTHORITY: Electric and Hybrid Vehicle Research, Development, and Demonstration Act of 1976, Pub. L. 94-413, 90 Stat. 1260 *et seq.* (15 U.S.C. 2501 *et seq.*), as amended by the Department of Energy Act of 1978—Civilian Applications, Pub. L. 95-238; Department of Energy Organization Act, Pub. L. 95-91, 91 Stat. 565 *et seq.* (42 U.S.C. 7101 *et seq.*).

SOURCE: 44 FR 57370, Oct. 4, 1979, unless otherwise noted.

§ 476.1 Purpose and scope.

This part establishes a program which makes planning grants available to qualified small business concerns which require assistance in developing, submitting and entering into contracts for research, development, or demonstration of electric or hybrid vehicles pursuant to section 9(c)(2) of the Electric and Hybrid Vehicle Research, Development, and Demonstration Act of 1976, Pub. L. 94-413, 90 Stat. 1260 *et seq.* (15 U.S.C. 2501 *et seq.*), as amended.

§ 476.2 Definitions.

As used in this part—"Act" means the Electric and Hybrid Vehicle Research, Development, and Demonstration Act of 1976, Pub. L. 94-413, 90 Stat. 1260 *et seq.* (15 U.S.C. 2501 *et seq.*), as amended.

"Affiliate" means "affiliate" as defined in 13 CFR Part 121.3-2(a).

"Annual receipts" means the gross income (less returns and allowances, sales of fixed assets, and interaffiliate transactions) of a concern (and its domestic and foreign affiliates) from sales of products and services, interest, rents, fees, commissions, and/or from whatever other source derived, as entered on its regular books of account for its most recently completed fiscal year and each of the two preceding years (whether on a cash, accrual, completed contracts, percentage of completion, or other acceptable accounting basis) and, in the case of a concern subject to U.S. Federal income taxation, reported or to be reported to the U.S. Treasury Department, Internal Revenue Service for Federal income tax purposes. If a concern has been in business less than 3 years, its average annual receipts shall be computed by determining its average weekly receipts for the period in which it has been in business, and multiplying such figure by 52. If a concern has acquired an affiliate during the applicable accounting period, it is necessary in computing the applicant's annual receipts to include the affiliate's receipts during the entire applicable accounting period, rather than only its receipts during the period in which it has been an affiliate. The receipts of a former affiliate are not included even if such concern had been an affiliate during a portion of the applicable accounting period.

"Concern" means any business entity organized for profit (even if its ownership is in the hands of a nonprofit entity) with its principal place of business located in the United States. "Concern" includes, but is not limited to, an individual, partnership, corporation, joint venture, association or cooperative. For the purpose of making affiliation findings, any business entity, whether organized for profit or not, and any foreign business entity, (i.e. any entity located outside the United States) shall be included.

"DOE" means the Department of Energy.

"Electric vehicle" means a vehicle which is powered by an electric motor drawing current from rechargeable storage batteries, fuel cells, or other portable sources of electrical current, and which may include a nonelectrical source of power designed to charge batteries and components thereof.

"Hybrid vehicle" means a vehicle propelled by a combination of an electric motor and an internal combustion engine or other power source and components thereof.

"Small business concern" means a concern which, including its affiliates, is independently owned and operated, (a) does not have assets exceeding $3.0 million as of the date of the latest available balance sheet of the concern, (b) does not have average annual receipts for the three preceding fiscal years in excess of $3.0 million, and (c) does not have an average annual net income (after Federal income taxes) for the three preceding fiscal years in excess of $300,000 (to be computed without any benefit of carryover losses), or if a concern has been in business less than three fiscal years, such average annual income shall be based on the relevant period it has been in existence.

"United States" means each of the several States, the territories and possessions of the United States, the Commonwealth of Puerto Rico and the District of Columbia.

§ 476.3 General requirements.

Except where this part provides otherwise, the award and administration of financial assistance under this part will be governed by—

(a) 10 CFR Part 600, entitled "Assistance Regulations";

(b) Such other requirements applicable to this part as DOE may from time to time prescribe; and

(c) Any Federal requirements applicable to grants under this part.

§ 476.4 Eligibility requirements.

Grants under this part may be made only to small business concerns which lack adequate funds to develop, prepare and submit proposals for entering into contracts for research, development or demonstration of electric or hybrid vehicles under the Act.

§ 476.5 Program solicitation.

(a) Subject to the availability of funds, DOE will solicit applications for planning grants, at least once each year, by issuing a program solicitation. Planning grants may be awarded only in response to the program solicitation.

(b) Each program solicitation shall set forth the requirements and procedures for applying for grants under this part, including—

(1) An explanation of the planning grant program and how to prepare and submit applications;

(2) A time schedule for submission of, and DOE action on, applications;

(3) The place for and manner of submission of applications;

(4) A unique number for identification purposes;

(5) The eligibility requirements;

(6) The evaluation criteria and their relative importance;

(7) An explanation of the evaluation and selection procedures;

(8) The specific problems or areas of concern, if any, which DOE is emphasizing in its funding of research, development or demonstration of electric or hybrid vehicles under the Act;

(9) A statement notifying potential applicants that the program solicitation does not commit DOE to pay any application preparation costs and that DOE reserves the right to award planning grants to any, all or none of the applicants;

(10) The total estimated amount of funds which will be available for the award of planning grants pursuant to the program solicitation;

(11) An explanation of how late applications will be handled;

(12) A copy of DOE's "Guide for the Submission of Unsolicited Proposals,"

or such other similar documents as DOE may from time to time issue;

(13) The required terms and conditions which will be included in grant instruments;

(14) The budget and financial status formats to be submitted with the application by which the applicant is required to substantiate its qualifications as a small business concern, the amount of the requested grant, and the applicant's financial need therefor;

(15) A statement notifying potential applicants that whenever an application contains information which may be exempt by law from public disclosure, it shall be handled in accordance with the procedures in 10 CFR 1004.11.

(16) A DOE contact (name and telephone number) for additional information; and

(17) Copies of any portions of those materials listed in § 476.3 with which grantees will be required to comply.

(c) Timely notice of the program solicitation will be published in the FEDERAL REGISTER, Commerce Business Daily, trade and professional journals and newspapers. Timely notice of the program solicitation will also be distributed directly to potential applicants to the extent considered necessary by DOE to assure adequate publicity and opportunity for participation.

§ 476.6 Evaluation and selection.

(a) Each application will undergo a preliminary review to determine whether it has been completed in accordance ith the requirements of the program solicitation and whether the applicant meets the eligiblity requirements. If this preliminary review reveals that the applicant does not meet the eligibility requirements, has failed to submit required financial and budgetary information or has omitted other required substantive information, the application shall be rejected and a prompt reply shall be sent to the applicant stating the reason(s) for the rejection. Applications with nonsubstantive or minor omissions or defects shall not be rejected. The applicant shall be notified of such omission or defect and must correct it prior to the award of a grant.

(b) Applications which successfully pass the preliminary review in accordance with paragraph (a) of this section will be evaluated and ranked based on the following criteria:

(1) The technical merit and quality of the research, development or demonstration project for which the applicant intends to develop a proposal, including such considerations as:

(i) Its potential for making a significant contribution to accelerating the introduction of electric and hybrid vehicles into the nation's transportation fleet;

(ii) Its potential for making a significant contribution to solving, or helping to solve, major problems facing the EHV programs; and

(iii) The problems which must be solved before the anticipated results of the proposal may make a meaningful contribution, and the applicant's recognition and acknowledgment of those problems and their need to be resolved.

(2) The capability of the applicant to successfully carry out the proposal, as measured by the following factors:

(i) The qualifications of the applicant's personnel;

(ii) The adequacy of the applicant's facilities; and

(iii) The quality of discussion and analysis in the application.

(3) The reasonableness of the applicant's budget for the preparation of the proposal.

(c) DOE will select applicants for planning grant awards taking into account the evaluation of the applications under paragraph (b) of this section and the availability of funds.

§ 476.7 Allowable expenditures.

Planning grant funds may be used only for the direct costs, and other identified costs normally included as overhead, incurred by the grantee in developing, preparing and submitting proposals to DOE. No profits or fees may be added to the grantee's direct costs.

§ 476.8 Contract proposals.

(a) When DOE receives an application for a planning grant for the development, preparation and submission of a proposal for entering into a contract for research, development or demonstration activities under the Act which falls within the scope of a current or pending DOE solicitation notice, DOE will furnish the applicant a copy of the solicitation notice when available. If the applicant is awarded a planning grant in these circumstances, its proposal will be considered as being in response to the solicitation notice.

(b) All other contract proposals will be considered as unsolicited proposals.

PART 478—METHANE TRANSPORTATION RESEARCH AND DEVELOPMENT; REVIEW AND CERTIFICATION OF CONTRACTS, GRANTS, COOPERATIVE AGREEMENTS, AND PROJECTS

Sec.
478.1 Purpose and scope.
478.2 Definitions.
478.3 Development of information on industry research and development.
478.4 Review of DOE program plans.
478.5 Required information from applicant.
478.6 Review and certification by manager.
478.7 Disclosure and reviewability of certification.
478.8 Standards and criteria.

AUTHORITY: Methane Transportation Research, Development, and Demonstration Act of 1980, Pub. L. 96-512, 94 Stat. 2827 (15 U.S.C. 3801); Department of Energy Organization Act, Pub. L. 95-91, 91 Stat. 565 (42 U.S.C. 7101 Note).

SOURCE: 47 FR 13705, Mar. 31, 1982, unless otherwise noted.

§ 478.1 Purpose and scope.

These regulations implement section 4(d) of the Methane Transportation Research, Development, and Demonstration Act of 1980 (15 U.S.C. 3801), and apply to each new contract, grant, cooperative agreement, Department of Energy (DOE) project, or other agency project funded or to be funded under the research and development authority conveyed upon the Secretary of Energy by that Act. These regulations do not apply to subcontractors, contractors under grants or cooperative agreements, or to contracts, grants, cooperative agrements, DOE projects, or other agency projects entered into, made, or formally approved and initiated prior to December 12, 1980, or with respect to any renewal or extension thereof. Insofar as contracts, grants, and cooperative agreements are concerned, these regulations provide procedures and requirements, in addition to those generally applicable under the assistance and procurement regulations of the Federal agency funding the research and development under the Act.

§ 478.2 Definitions.

For purpose of these regulations—

"Act" means the Methane Transportation Research, Development, and Demonstration Act of 1980, Pub. L. 96-512; 94 Stat. 2827 (15 U.S.C. 3801).

"Agency project" means research and development requested by DOE under the Act performed by employees of a Federal agency or of a national laboratory operated for a Federal agency.

"Applicant" means any private laboratory, university, nonprofit organization, industrial organization, private agency, institution, organization, corporation, partnership, individual, or public agency other than a Federal agency.

"DOE" means the United States Department of Energy.

"DOE project" means research and development under the Act by employees of DOE or of a national laboratory operated for DOE.

"Federal agency" means an executive agency as defined by 5 U.S.C. 105.

"Manager" means the Federal program official who requests that a contracting or grants officer negotiate a contract, grant, or cooperative agreement; who requests that a contracting officer authorize transfer of DOE funds for an agency project; or who authorizes a DOE project to begin.

"Methane" means either natural gas (as defined in 2(1) of the Natural Gas Policy Act of 1978), gas derived from coal, liquefied natural gas, or any gaseous transportation fuel produced from biomass, waste products, and other renewable resources.

"Related facilities" means any facility for the transmission, storage, or dispensing of methane fuel for vehicles.

"Research and development" means activities constituting a project to advance the state of the art of methane-fueled vehicles or related facilities and does not mean activities involving technology transfer to mass production, evaluative testing, preliminary planning for a DOE or an agency project, or program administration and management.

"Solicitation" means a formal, written request for proposals/applications to perform research and development under a contract, grant, or cooperative agreement, typically including evaluation criteria and a statement of the work to be done or areas to be investigated.

"Vehicle" means any truck, van, station wagon, bus, or car used on public roads or highways as well as off-road agricultural equipment, such as tractors, harvesters, and so forth, which currently burn gasoline or diesel fuel.

§ 478.3 Development of information on industry research and development.

Before completing program planning for each fiscal year, the manager shall search appropriate data archives to identify planned, ongoing, or completed research and development on methane-fueled vehicles and related facilities. In addition, when necessary the manager shall contact private sector entities to determine the nature of any research and development of this kind which they may be planning or conducting. This information, which will provide a data base for making certifications under § 478.6, shall be compiled and made available to the public, after removal of any proprietary information as described in 10 CFR 1004.10(b)(4).

§ 478.4 Review of DOE program plans.

In formulating a program plan for the program authorized by the Act, the DOE manager shall make the draft program plan available for review and shall solicit comments from persons, in both the private sector and other Federal agencies, concerned with research and development of methane-powered vehicles and related facilities. At the same time, the manager shall place in the *Commerce Business Daily* and the FEDERAL REGISTER notices that the plan is available for comment. The manager shall take these comments into account in ensuring that planned projects will not supplant, duplicate, displace, or lessen private sector activities as provided in the Act. The manager shall maintain and make available a record of the comments solicited and received, and shall include in the program plan a discussion of the consideration of the comments.

§ 478.5 Required information from applicant.

Any proposal for a contract, grant, or cooperative agreement, under the Act to support research and development activities of methane-fueled vehicles or related facilities must—

(a) State whether the activities will initiate or continue research and development of methane-fueled vehicles or related facilities;

(b) State, insofar as the applicant has information, whether and to what extent the activities to be supported are technically the same as activities conducted previously or to be conducted during the term of the award by any person for research and development of a substantially similar methane-fueled vehicle or related facility;

(c) Justify research and development activities on methane-fueled vehicles or related facilities abandoned by any person because of a lack of mass production potential by presenting information showing a significant intervening technological advance, promising conceptual innovation, or other special consideration;

(d) Provide an assurance that the amount of the applicant's own funds to be expended for research and development of methane-fueled vehicles or related facilities will not be diminished as a result of the award of a contract, grant, or cooperative agreement.

(e) Provide to the extent possible—

(1) An assurance that the time period for completing research and development of the methane-fueled vehi-

cles or related facilities is likely to be shorter as a result of a contract, grant, or cooperative agreement; and

(2) The estimated delay, if any, which is likely to occur if the application for a contract, grant, or cooperative agreement is denied.

Information required from the applicant shall also be set forth in the solicitation notice for a contract, grant, or cooperative agreement.

EDITORIAL NOTE: Section 478.5, published at 47 FR 13705, Mar. 31, 1982, contains information collection requirements which will not be effective until OMB approval has been obtained.

§ 478.6 Review and certification by manager.

(a) The manager shall reject any proposal that has not been completed in accordance with § 478.5 of these regulations or any other generally applicable requirements for the submission of proposals. A rejected proposal may be corrected, amended or resubmitted as permitted by the applicable procedures under the assistance and procurement regulations of the Federal agency receiving the proposal.

(b) After the preliminary review and prior to recommending that contracting officials negotiate an award, the manager shall review the proposed research and development to be performed under contract, grant, or cooperative agreement, to determine whether the proposed project meets the standards and criteria of § 478.8.

(c) Upon consideration of all relevant information, including the DOE program plan, any applicable comments on the program plan, information on private-sector research and development programs compiled annually under § 478.3, and all material submitted by the applicant, the manager—

(1) Shall determine whether the research and development to be performed complies with the standards and criteria of § 478.8;

(2) Shall obtain the concurrence of DOE on the certification decision, either affirmative or negative, if the manager is not an employee of DOE;

(3) Shall, in the event of a negative determination under this section, advise the applicant of the decision in writing with a brief statement of supporting reasons; and

(4) Shall, in the event of an affirmative determination under this section, prepare a certification—

(i) Explaining the determination;

(ii) Discussing any allegedly related or comparable industrial research and development considered and not deemed to be an adequate basis for not certifying the contract, grant or cooperative agreement;

(iii) Discussing issues regarding cost sharing and patent rights related to the standards and criteria of § 478.8 of these regulations; and

(iv) Discussing any other relevant issue.

(d) After complying with paragraph (c) of this section, the manager shall sign the certification and distribute copies to the applicant, if any and to DOE, if the manager is not a DOE employee—

(1) Immediately in the case of a DOE or agency project; and

(2) After the agreement has been negotiated in the case of a contract, grant, or cooperative agreement. The applicant's copy shall accompany the award. In this case, the manager shall informally notify the applicant of the outcome of his decision under paragraph (c)(1) of this section as soon as possible after it is made.

§ 478.7 Disclosure and reviewability of certification.

Any certification issued under these rules is—

(a) Subject to disclosure under 5 U.S.C. 552 and section 17 of the Federal Nonnuclear Energy Research and Development Act of 1974, as amended (42 U.S.C. 5918); and

(b) Available to the Committee on Science and Technology of the House of Representatives and the Committee on Energy and Natural Resources of the Senate; and

(c) Subject neither to judicial review nor to the provisions of 5 U.S.C. 551-559, except as provided under paragraph (a) of this section.

§ 478.8 Standards and criteria.

Research and development to be performed under a contract, grant, or cooperative agreement, as a DOE project, or as an agency project under the Act may be certified under these regulations only if the research and development to be conducted—

(a) Supplements the research and development efforts of industry or any other researcher on methane-fueled vehicles or related facilities;

(b) Is not duplicative of efforts previously abandoned by private researchers unless the project has been justified by an intervening technological advance, promising conceptual innovation, or other special consideration;

(c) Would not be performed during the term of the award but for the availability of the Federal funding being sought;

(d) Is likely to produce an advanced methane-fueled vehicle or related facility suitable for steps toward technology transfer to mass production in a shorter time period than would otherwise occur;

(e) Is not technologically the same as efforts, by any person, conducted previously or to be conducted during the term of the award regarding a substantially similar advanced methane-fueled vehicle or related facility; and

(f) If not likely to result in a decrease in the level of private resources expended for research and development on methane-fueled vehicles and related facilities by substituting Federal funds without justification.

PART 490—EMERGENCY BUILDING TEMPERATURE RESTRICTIONS

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AUTHORITY: Federal Energy Administration Act of 1974, (15 U.S.C. 761 et seq.); Energy Policy and Conservation Act, (42 U.S.C. 6201 et seq.), as amended; Department of Energy Organization Act, (42 U.S.C. 7101 et seq.); EO 11790, 39 FR 23185 (June 27, 1974); EO 12009, 42 FR 4627 (Sept. 15, 1977); Standby Conservation Plan No. 2, Emergency Building Temperature Restrictions, 44 FR 12906 (Mar. 8, 1979); EO 11912, 41 FR 15825 (Apr. 13, 1976); Presidential Proclamation No. 4667, 44 FR 40629 (July

12, 1979); and Presidential Proclamation No. 4750, 45 FR 26019 (Apr. 17, 1980).

SOURCE: 46 FR 8415, Jan. 26, 1981, unless otherwise noted.

Subpart A—Scope and Definitions

§ 490.1 Scope.

Except as otherwise provided in this part, this part applies to covered buildings in each state or political subdivision thereof, and shall supercede any law of any state or political subdivision thereof or any Federal order, regulation or directive, to the extent such law, order, regulation or directive is inconsistent with these regulations or any guidelines or orders issued pursuant thereto.

§ 490.2 Effective date.

These regulations first took effect on July 16, 1979, and, by Presidential Proclamation of April 15, 1980, will continue to be effective through January 16, 1981. The regulations may be terminated or suspended by the President at any time.

§ 490.3 Authority to contract or delegate.

DOE may delegate or contract for the carrying out of all or any part of the functions under this part.

§ 490.4 Authority to issue orders and guidelines.

DOE may issue such orders and guidelines, and may make such adjustments, as are necessary to administer and implement the provisions of these regulations.

§ 490.5 Definitions.

(a) "Capability for simultaneous heating and cooling" means an HVAC system that can supply heating to one part of the space-conditioning equipment while at the same time supplying cooling to another, including but not limited to dual-duct, reheat, recool, multizone fans, fan-coil units in combination with central air and induction units in combination with central air.

(b) "Cooling season" means those periods when the HVAC system in a covered building is operated such that no space heating is being used in that building.

(c) "Covered building" means every building or portion of a building, but excludes residential buildings, hotels or other lodging facilities, hospitals and health care facilities, elementary schools, nursery schools and day-care centers, and such other buildings and facilities as the Secretary may by rule determine: *Provided*, That to the extent that the non-sleeping facilities of a hotel, motel or other lodging facility have space-conditioning control devices separate from the sleeping facilities, the non-sleeping facilities are not excluded from the definition.

(d) "Dew point temperature" means the temperature at which condensation of water vapor begins as the temperature of the air-vapor mixture is reduced. When the dry-bulb temperature equals the dew point temperature, the relative humidity is 100 percent.

(e) "DOE" means the Department of Energy.

(f) "Domestic hot water" means hot water which is intended for use in covered buildings for personal hygiene or general cleaning.

(g) "Dry-bulb temperature" means the temperature of air as measured by a dry-bulb, or ordinary thermometer which directly measures air temperature. Where unusual radiant heat gain or loss, or where unusually high air velocity conditions prevail, an adjusted dry-bulb temperature may be calculated in accordance with American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE) Standard 55-74 Thermal Environmental Conditions for Human Occupancy. Alternatively, Temperature may be read directly using a Vernon-type globe thermometer.

(h) "Elementary School" means any school which has any grades kindergarten through sixth grade, provided, that if the non-elementary grade portions of a building have space-conditioning control devices separate from the elementary portions, the non-elementary grade portions are not included within the definition of elementary school.

(i) "Fuel distributor" means any person who delivers oil or other fuel for use in a covered building.

(j) "Heating season" means those periods when the HVAC system in a covered building is operated such that no space cooling energy is used in that building.

(k) "Humidity" means a measure of the water-vapor content of air.

(l) "HVAC" means Heating, Ventilating and Air Conditioning.

(m) "HVAC System" means a system that provides either collectively or individually the processes of space heating, ventilating and/or air conditioning within or associated with a building.

(n) "Hospital and health care facility" means a building such as a general hospital, tuberculosis hospital or any other type of hospital, clinic, nursing or convalescent home, hospice or other facility duly authorized to provide hospital or health care services under the laws of the jurisdiction in which the institution or facility is located, but does not include the offices of physicians, dentists and other members of health care professions licensed by the State to provide health related services, which are not located in such a building.

(o) "Hotel or other lodging facility" means a building where sleeping and lodging accommodations are provided to the public, or to the members of a private membership organization or other private facility, in the ordinary course of business.

(p) "Occupied period" means that time of the day or night when the covered building or portion thereof is used for its ordinary function or functions.

(q) "Operator" means any person, whether lessee, sublessee or assignee, agent or other person, whether or not in physical possession of a covered building, who has control, either directly or indirectly through an agent, of heating, cooling or hot water equipment servicing the covered building.

(r) "Owner" means any person, whether or not in physical possession of a covered building, in whom is vested legal title, and who has control, either directly or indirectly through an agent, of heating, cooling or hot water equipment servicing the covered building.

(s) "Person" means any individual, corporation, company, association, firm, partnership, society, trust, joint venture, or joint stock company, the United States or any State or political subdivision thereof, the District of Columbia, Puerto Rico, any U.S. territory or possession, or any agency of the United States or any State or political subdivision thereof, or any other organization or institution.

(t) "Public utility" means a publicly or privately owned and operated utility which is engaged in the sale of electric power or natural gas to end-users.

(u) "Relative humidity" means the ratio of the amount of water vapor in the air at a specific temperature to the maximum water vapor capacity of the air at that temperature.

(v) "Residential building" means any building used for residential purposes but does not include any portion of such building used for commercial, industrial or other business purposes and which, with respect to the heating and cooling requirements of these regulations, has separate heating or cooling space-conditioning control devices or, with respect to water temperature restrictions, has separate hot water temperature control devices.

(w) "Room" means that portion of the interior space which is contained within the exterior surfaces of a building, which is contained within floor to ceiling partitions, and which is conditioned directly or indirectly by an energy using system.

(x) "Secretary" means the Secretary of the Department of Energy.

(y) "Solar Energy" means energy derived from the sun directly through the solar heating of air, water and other fluids; indirectly through the use of electricity produced by solar photovoltaic or solar thermal processes; or indirectly through the use of wind, geothermal, small scale water power or biomass, including wood, and any combustible municipal or industrial trash or waste materials.

(z) "Space-conditioning control device" means a device for directly or indirectly controlling the room temperature and/or humidity by means of the HVAC system.

(aa) "Special equipment" means equipment for which carefully controlled temperature levels are necessary for proper operation or maintenance.

(bb) "State" means any State, the District of Columbia, Puerto Rico, or any territory or possession of the United States.

(cc) "Temperature control device" means a thermostat or any other device used to regulate the operation of heating or cooling equipment or a hot water heater.

(dd) "Unoccupied" means those periods eight hours or longer of the day or night other than the occupied period.

(ee) "Wet-bulb temperature" means the temperature of air as measured by a wet-bulb thermometer, which is a thermometer having the bulb covered with a cloth, usually muslin, that is saturated with water.

(ff) "Coolant" means the liquid which is circulated through heat exchangers for the purpose of removing heat from the air. The coolant may be circulating water, refrigerant itself, or another fluid.

(gg) "Energy that would otherwise be wasted" means any heating energy rejected by any equipment of process, which can be employed directly or indirectly to provide for space heating or cooling or for domestic water heating without increasing the load on the original equipment.

(hh) "Intermediate season" means any time when both heating and cooling are being supplied to the entire building, but at different times on the same day, or are being supplied at the same time to different spaces in the building.

(ii) "Reheat" means the process of first cooling supply air and then raising the temperature again, by passing it over a heated surface or by mixing with warm air or by any other method, before introduction into living space.

(jj) "Work station" means the location within a room where an employee ordinarily performs his or her principal work related tasks.

Subpart B—Heating and Cooling Restrictions

§ 490.11 HVAC systems without capability for simultaneous heating and cooling.

In covered buildings with HVAC systems without the capability for simultaneously heating and cooling the building:

(a) No operator shall set space-conditioning control devices so that energy is consumed to raise the room dry-bulb temperature above 65° F.;

(b) No operator shall set space-conditioning control devices so that energy is consumed to lower the room dry-bulb temperature below 78° F.: *Provided*, That energy may be consumed to lower the room dry-bulb temperature below 78° F. to the extent necessary to lower the room dew-point temperature to 65° F.

§ 490.12 HVAC systems with capability for simultaneous heating and cooling.

In covered buildings with HVAC systems capable of simultaneous heating and cooling of the building or portions thereof, operators shall set space-conditioning control devices in accordance with the following requirements:

(a)(1) Except as otherwise provided in this section, no operator shall set space-conditioning control devices so that energy is consumed to raise the room dry-bulb temperature above 65° F.

(2) Except as otherwise provided in this section, no operator shall set space-conditioning control devices so that energy is consumed to lower the room dry-bulb temperature below 78° F.: *Provided*, That energy may be consumed to lower the room dry-bulb temperature below 78° F. to the extent necessary to lower the room dew-point temperature to 65° F.;

(3) During the intermediate season, at those times or in those areas where heat is being supplied to a room, operators of HVAC systems must comply with the requirements of paragraph (a)(1) of this section. During the intermediate season, when cooling, operators must comply with the requirements of paragraph (a)(2) of this section, or alternatively with paragraph (b)(1)(ii) of this section for operators

of fan-coil, induction, baseboard, or similarly operated units, or paragraph (d)(1)(i) of this section for operators of "all-air" systems.

(b)(1) Operators of systems where the cooling or heating of room air takes place in equipment located in the occupied space (fan coil, induction, baseboard or similarly operated units) shall set space-conditioning control devices in accordance with the requirements of paragraph (a) of this section, or alternatively in the following manner.

(i) No heat is provided to the heating coil during the cooling season,

(ii) No liquid coolant is provided to the cooling coil at coolant temperatures below 55° F., and

(ii) No heat is supplied to a room if the room dry-bulb temperature is greater than 65° F.

(2) Operators of fan-coil, induction, baseboard or similarly operated units may alternate at any time between the requirements of paragraphs (a) and (b)(1) of this section.

(c) Operators of heat-pump systems shall set space-conditioning control devices in accordance with the requirements of paragraph (a) of this section.

(d)(1) in lieu of complying with the requirements of paragraph (a) of this section, operators of HVAC systems in which the room temperature is controlled by varying the temperature or flow volume of air which is introduced into the occupied space ("all-air" systems, including those with reheat) may set space-conditioning control devices so that:

(i) The dry-bulb temperature of the air leaving the cooling coils is 60° F. or greater,

(ii) During the cooling season, the heating coil is turned off and the space-conditioning control device is set to 78° F., and

(iii) During the heating season, if the heating coil is turned on, the space-conditioning control device is set to 65° F.

(2) Operators of HVAC systems in which the room temperature is controlled by varying the temperature or flow volume of the air which is introduced into occupied space may alternate at any time between the requirements of paragraphs (a) and (d)(1) of this section.

(e)(1) Notwithstanding the requirements of any other subsection of this section, where a licensed professional engineer certifies by analysis that operation of a covered building in accordance with the requirements of paragraph (e)(2) of this section during periods prescribed in the analysis will result in the consumption of less energy than compliance with the requirements of paragraphs (a) through (d) of this section, that building may be operated in accordance with the requirements of paragraph (e)(2) of this section during those periods.

(2) For covered buildings qualified under the provisions of paragraph (e)(1) of this section, space-conditioning control devices shall be set at levels consistent with maximum energy savings, and the cooling system shall be adjusted such that:

(i) No liquid coolant is provided to the cooling coil at coolant temperatures below 55° F.; or

(ii) The dry-bulb temperature of the air leaving the cooling coils is 60° F. or greater.

(3) When a building or portion thereof is being cooled the use of reheat or other form of heat addition is prohibited, except that when an occupied covered building with a balanced distribution system is being cooled to a dry bulb temperature of 78 degrees or higher (or to another temperature permitted by a claimed exemption or approved exception) and the dry bulb temperature of any part or parts of the building falls to 65 degrees or below, heat may then be added to those part or parts by means of reheat equipment, portable electric heaters, opening the window or by any other method. In such cases heat may be added to maintain no more than 65° F. in those occupied parts in which the temperature would otherwise be less than 65° F. When reheat is thus added the temperature of the air leaving the cooling coils must be held at 60° F. or greater, unless by so doing the temperature in other rooms would become higher than 78° F. in which case a supply air temperature which is no lower than necessary to maintain a

minimum of 78° F. in those other rooms is permitted.

(4) When compliance with the requirements of paragraphs (a), (b)(1), (d)(1), or (e)(2) of this section would subject the compressor to the likelihood of damage, the coolant temperature may be lowered to the temperature level necessary to prevent such damage.

(5) Operators of covered buildings qualified under the provisions of paragraph (e)(1) of this section may alternate at any time between the requirements of paragraphs (a) and (e)(2) of this section.

(6) The certified analysis by a licensed professional engineer shall be made available to DOE or its delegate upon request.

(7) It shall be deemed a violation of the requirements of this part for a licensed professional engineer to falsely certify the analysis authorized by paragraph (e)(1) of this section.

§ 490.13 Requirement for accuracy of space-conditioning control devices.

(a) The operator of a covered building shall maintain within reasonable tolerances of accuracy and repair the space-conditioning control devices used to control temperature or humidity.

(b) No person may alter or relocate a space-conditioning control device to thwart the intent of these regulations, or to bring about room temperatures prohibited elsewhere in these regulations.

§ 490.14 Regulation of building temperatures during unoccupied periods.

(a) During periods any covered building is unoccupied eight hours or more before the next normal occupied period:

(1) The heating system for that building shall not be operated if the anticipated minimum outdoor air dry-bulb temperature for the unoccupied period is greater than 50° F., and the cooling system for that building shall not be operated. The requirements of this subsection may be satisfied by turning off the circulating air or circulating water system.

(2) If the anticipated minimum outdoor air dry-bulb temperature for the unoccupied period is less than 50° F., the space-conditioning control devices for the heating system for that building shall be set such that one of the following results:

(i) The room dry-bulb temperature is less than 55° F.;

(ii) The heated supply-air dry-bulb temperature is less than 100° F.;

(iii) The heating-water dry-bulb temperature is less than 120° F.; or

(iv) The space-conditioning control devices are set at less than 55° F., or at their lowest set point.

(3) HVAC system operation during unoccupied periods is permitted where requested by the public utility or district heating system servicing the building for purposes of load management.

(4) Notwithstanding the requirements of this section:

(i) HVAC system operation during unoccupied periods is permitted to the extent necessary to prevent damage to the covered building or its contents;

(ii) The HVAC system may begin operating at such time so that the temperature levels authorized by this subpart may be reached at a time simultaneous with the beginning of the occupied period.

(5) When a building is heated by a heat pump such that the requirements of paragraphs (a) (1) and (2) of this section may result in higher monthly peak demand or increased monthly energy consumption, or both, the space-conditioning control device during unoccupied periods may be set at 60° F.

§ 490.15 Auxiliary heaters.

No auxiliary heating devices such as portable electric heaters, heat lamps or other devices whose principal function at the time of operation is to produce space heating may be operated except at such times that use of energy for heating purposes is authorized under the other sections of this subpart or when the covered building is unoccupied. When an auxiliary heating source is in use in a particular room or at a particular work station, the temperature in that room or at that work station shall not be brought above 65° F.

§ 490.16 Use of ventilating equipment.

Nothing in this subpart shall be deemed to prohibit the use of ventilating fan or pump power to heat a building to a dry-bulb temperature above 65° F. or to cool a building to a dry-bulb temperature below 78° F.

§ 490.17 Measurement techniques.

(a) Where a space-conditioning control device controls the temperature for more than one room, the measurement may be taken in the room containing the device or any other regularly occupied room controlled by that device. The room with the highest temperature when cooling and the lowest temperature when heating may be measured for purposes of determining compliance with the requirements of this subpart.

(b) Except as otherwise provided in this section, compliance with the requirements of this subpart shall be determined by reading the set-point of the space-conditioning control device which controls the temperature for the room.

(c) Any of the following methods for measuring dry-bulb temperature, dew-point temperature, relative humidity and wet-bulb temperature may be utilized in lieu of a reading of the set-point on the space-conditioning control device. An operator shall be deemed to have complied with any temperature or humidity requirement of this subpart so long as any one measurement technique indicates compliance with the relevant temperature or humidity requirement.

(1) Dry-bulb temperature shall be measured by:

(i) A thermometer placed within 24 inches of the space-conditioning control device;

(ii) The average of thermometer readings taken two feet away from and at the center of each external wall in the room, and at the center of the room;

(iii) If there are no external walls, the temperature at the center of the room; or

(iv) The average of thermometer readings taken at representative work stations in the room.

(2) Dew-point temperature shall be measured by:

(i) Observing the temperature of a glass at which condensation first occurs while cooling the glass;

(ii) By a dew-point indicating instrument; or

(iii) By inference from the wet-bulb temperature or the relative humidity.

(3) The relative humidity shall be measured by:

(i) A humidity-indicating instrument (hygrometer); or

(ii) By inference from the dew-point or wet-bulb temperature.

(4) The wet-bulb temperature shall be measured by:

(i) A wet-bulb-temperature-indicating instrument (psychrometer); or

(ii) By inference from the dew-point temperature or relative humidity measurement.

(5) The dew-point temperature, relative humidity and wet-bulb temperature may be measured within 24 inches of the humidity space-conditioning control device if located in the room, or in the same locations as used in the measurement of the dry-bulb temperature.

(6) To account for HVAC system cycling, all temperature and humidity readings may be taken as the average of several measurements taken at equal time intervals.

(7) Any temperature measurement shall be taken at between four and six feet from the floor.

(d) Before setting thermostats at the required level, the operator shall insure that the HVAC distribution system is properly balanced in accordance with generally accepted industry practice.

§ 490.18 Exemptions from heating and cooling restrictions.

(a) The requirements of this subpart shall not apply to:

(1) Covered buildings or portions thereof which are neither heated nor cooled or which are equipped with space heating devices and space cooling devices with total rated output less than 3.5 Btu per hour (1 watt) per square foot of gross floor area.

(2) Buildings containing HVAC systems capable of using outdoor air, cold well water or evaporation of water for cooling effect without operation of a

vapor compression or absorption-refrigeration system, but this exemption applies only with respect to cooling, and only during those periods when the outdoor air, cold well water and/or evaporation effect provides the only source for cooling.

(3) Buildings containing HVAC systems capable of using energy that otherwise would be wasted, but only during those periods when the otherwise wasted energy provides the only source of heating or cooling energy.

(4) Buildings containing HVAC systems capable of using solar energy, but only during those periods when solar energy provides the only source of heating or cooling energy.

(b) For buildings or portions of buildings where the capacity of the HVAC system is insufficient to maintain the building or portion thereof at the minimum temperature levels for cooling authorized by this regulation when the building or portion thereof is occupied, the operator of said building may cool the building or portion of the building to a temperature level below 78° F. before the building or portion of the building is occupied: *Provided*, That said reduced temperature level may only be maintained for the period of time necessary so that the temperature will reach the minimum level permitted by this regulation during the building's occupied period.

(c) Exemptions under this section may not be claimed when energy, other than waste, solar, pump or fan energy is used to operate a vapor compressor or absorption refrigerator.

Subpart C—Domestic Hot Water

§ 490.21 Regulation of hot water controls.

(a) The operator of a covered building shall set hot water temperature control devices so that the temperature of domestic hot water in such covered building does not exceed the greater of:

(i) 105° F., or

(ii) The lowest setting on the hot water temperature control device.

(b) The operator shall, where practicable, shut off domestic hot water circulating pumps during periods when a covered building is to be unoccupied for more than eight hours when such actions will not cause damage to the building, it systems, or internal processes or articles.

§ 490.22 Measurement of domestic hot water temperature.

(a) The temperature of domestic hot water shall be taken as the domestic hot water storage tank temperature measured in the hot water supply line, at the tank temperature control point, or at the tap nearest the tank discharge point.

§ 490.23 Maintenance of hot water temperature control devices.

(a) The operator of a covered building shall maintain all domestic hot water temperature control devices in that building within reasonable tolerances of accuracy and repair.

(b) No person may alter a hot water temperature control device with the intent of having that device function inaccurately.

§ 490.24 Exemption from hot water restrictions.

(a) The provisions of this subpart shall not apply in a covered building where the domestic hot water heating equipment also provides hot water for manufacturing, industrial, commercial or food preparation or handling processes and such processes or process clean-up procedures require hot water temperatures in excess of those prescribed in this subpart. In order to achieve the maximum possible energy savings, such temperature levels should be maintained at the minimum level necessary to provide for the exempted needs.

(b) The provisions of this subpart shall not apply in a covered building where domestic hot water is the only source available for dishwashing or other purposes in such covered building and state or local health regulations prescribe a minimum temperature level above 105° F. for dishwashing or such other purposes. Domestic hot water control devices shall be set so as not to exceed the minimum level required by the state or local health regulations.

(c) The provisions of this subpart shall not apply to combination domestic water heating/space heating boilers during the heating season.

(d) The provisions of this subpart shall not apply at such times that solar energy provides the only source for domestic hot water heating energy. At such times that a hot water heating system using a non-solar energy source is being operated in conjunction with solar energy, this exemption shall not apply.

(e) The provisions of this subpart shall not apply to domestic hot water heating systems capable of using heat that otherwise would be wasted, but only at such times when the waste heat provides the only source of hot water heating energy.

(f) Exemptions under this section may not be claimed when energy, other than waste, solar, pump or fan energy is used to operate a vapor compressor or absorption refrigerator.

Subpart D—Exemptions

§ 490.31 General exemptions.

(a) In addition to the exemptions provided in other subparts, and subject to the limitations of this subpart, the following exemptions from the requirements of Subpart B or C of this part are available to any person for a building or portion of a building in accordance with the provisions of this section:

(1) Where a "manufacturer's warranty", service manual or equipment service contract requires specific temperature levels to prevent damage to special equipment.

(2) Where maintenance of certain temperature and humidity levels is critical to materials and equipment used in manufacturing, industrial or commercial processes.

(3) Where maintenance of certain temperature and humidity levels is required for the proper storage or handling of food or other agricultural commodities, raw materials, goods in process and finished goods.

(4) Any other circumstances where special environmental conditions are required to protect plant life essential to the operation of a business within a covered building, materials or animal life.

(5) Where maintenance of certain temperature levels is required:

(i) To protect the health of persons in offices of physicians, dentists and other members of health care professions licensed by the state to provide health-related services;

(ii) To protect the health of persons engaged in rehabilitative physical therapy in physical therapy facilities;

(iii) With respect to restrictions on heating only, to protect the health of persons utilizing indoor swimming pools;

(iv) To protect the health of individuals required by security, safety or health regulations to wear special or protective clothing to perform manufacturing, inspections or other industrial functions; or

(v) With respect to restrictions on heating only, to protect the health of persons in workplace or school shower and changing rooms where showers are part of customary work or school procedure.

(6) Where the structure or insulation of the building will be damaged.

(7) Where nutritional, recreational, and other facilities are specifically designated for use by senior citizens the thermostat may be adjusted to raise the dry-bulb temperature to 70 degrees F. during the heating season; except that this exemption applies only when senior citizens activity is being conducted and only to those portions of the facilities used for senior citizen activity.

(b) Exemptions claimed under Subparts B, C, and D of this part shall become effective when claimed.

(c) Any person claiming an exemption under any provision of Subparts B, C, or D of this part shall provide the owner or operator of the covered building with all necessary information relating to the exemption including:

(1) The nature of the exemption and the section of the regulations claimed as the basis for exemption;

(2) The portions of the building for which the exemption is claimed;

(3) The required temperature levels in the exempt portions of the building

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consistent with maximum energy savings.

(d) The owner or operator of a covered building shall, upon request of DOE or its delegate, make available any information provided to the owner or operator under paragraph (c) of this section.

(e) Any person who claims an exemption to which he is not entitled is subject to the penalties provided in Subpart G of this part.

(f) Where the person entitled to an exemption under this part is not the owner or operator of the covered building(s) to which the exemption applies, the owner or operator of the covered building(s) is authorized to adjust space-conditioning control devices and hot water temperature control devices in accordance with § 490.34.

(g) Any operator, other than an operator who claims an exemption, shall not be liable for violation of this part as the result of acting in reliance upon an exemption which subsequently is determined to be invalid.

§ 490.32 Specific exceptions.

(a) In addition to the general exemptions available under § 490.31 or under Subparts B and C of this part, any person who would experience special hardship, inequity or an unfair distribution of the burden as a result of the requirements of Subparts B and C of this part may submit an "Application for Exception" in accordance with Subpart D of Part 205 of this chapter. An exception shall not become effective until such time as it is granted by DOE.

(b) If the person submitting the "Application for Exception" is not the owner or operator of the covered building(s) to which the requested exception is to apply, and if the exception is granted by DOE, then the owner or operator of the covered building(s) is authorized to adjust space-conditioning control devices and hot water temperature control devices in accordance with the provisions of the exception provided by DOE.

(c)(1) Any person who receives an approved exception under paragraph (a) of this section shall provide the owner or operator of the covered building with all necessary information relating to the exception including:

(i) The nature of the exception;

(ii) The portions of the building for which the exception is claimed;

(iii) The authorized temperature levels in the excepted portions of the building as determined by the terms of the exception or consistent with maximum energy savings.

(2) The owner or operator of a covered building shall, upon request of DOE or its delegate, make available any information provided to the owner or operator under paragraph (c)(1) of this section.

§ 490.33 Limitation of exceptions or exemptions.

(a) Where a portion of a covered building qualifies for an exemption under § 490.31 or any provision of Subparts B and C of this part, or for an exception under § 490.32, the operator may set temperature levels other than those prescribed in Subparts B and C of this part only for such portions of the covered building as necessary to maintain temperatures for the exempted sections. In those covered buildings where the space-conditioning control device or hot water temperature control device controls both the exempt and non-exempt portions of the building, the entire building or portion of the building may operate as if exempted from the temperature requirements of Subparts B and C.

(b) DOE may limit the exemption or exception granted by this part to all or any portion of a covered building. DOE may specify heating, cooling or hot water temperature controls to be applicable in the excepted portion of a covered building.

§ 490.34 Scope of exceptions or exemptions.

The operator of a covered building subject to an exemption or exception pursuant to this part shall, where practicable, maintain the temperature levels prescribed in Subparts B and C of this part, or such other levels consistent with maximum energy savings. When an exemption is claimed or an exception granted, the building owner or operator, or both, shall, upon notification, and without undue delay, take no further action to impose the temperature limits specified by those regulations in that portion of the building covered by the exemption or exception.

§ 490.35 Exemption procedures for states.

(a) A state or political subdivision thereof may seek an exemption from the application of this part in such state or political subdivision during a period for which the President of the United States or his delegate determines a comparable program of such state or political subdivision is in effect. The comparable program may include procedures permitting any person affected by the regulations to use alernative means of conserving at least as much energy in affected buildings as would be conserved by the temperature restrictions.

(b) A state or political subdivision thereof seeking an exemption on the ground that a comparable program is in effect shall submit to the secretary a "Request for Exemption" which shall include the following information:

(1) A full description of the comparable program, including the authority which allows for the mandatory imposition of the program;

(2) An estimate of the types and amount of energy which such program will conserve;

(3) The effective dates of the program;

(4) A description of energy conservation measures implementable at the state or local level and their expected energy savings;

(5) A comparison of energy savings estimated to result in that state or political subdivision from compliance with these regulations and estimated energy savings under the proposed comparable program which demonstrates that the comparable program conserves at least as much energy in the state or political subdivision as these regulations. The comparisons shall be performed using a consistent methodology for estimating building energy consumption.

(6) A description of procedures for the approval on a building-by-building basis of the alternative means and for enforcement of such alternative means by such state or political subdivision.

(7) Such other information as the Secretary may require.

(c) A request for exemption by a state or political subdivision shall be sent to the cognizant Regional Representative of the Secretary of Energy having jurisdiction over such State or unit of local government.

(d) For purposes of this section: "Comparable program" means a plan which is mandatory and which conserves at least as much energy in the state or political subdivision thereof as adherence to the requirements of these regulations would be expected to conserve in such state or political subdivision. The comparable program need not conserve energy in the same fashion as the building temperature restrictions require.

Subpart E—General Provisions

§ 490.41 Joint and several liability.

The owner and operator shall be jointly and severally liable for the execution of operator responsibilites under this part where an agency relationship exists between the owner and operator.

§ 490.42 Reporting requirement.

Any public utility or any fuel distributor shall make available to the DOE, upon request, customer lists or other information deemed necessary by DOE to administer and enforce these regulations.

§ 490.43 Self-Certification and Filing of Building Compliance Information Form.

(a) (1) The owner or operator of a covered building shall, within 30 days of the effective date of this regulation, complete in accordance with forms and instructions provided by DOE, and post in a prominent location within the covered building, a "Certificate of Building Compliance" certifying compliance with the requirements of this part.

(2) The "Certificate of Building Compliance" shall set forth exemptions claimed by any persons within the covered building, or any author-

ized exceptions claimed by persons within the building.

(b) In addition to the requirements of paragraph (a) of this section, the owner or operator of a covered building shall, within 30 days of the effective date of this regulation, submit to DOE in accordance with forms and instructions to be provided by DOE a "Building Compliance Information Form" describing any exemptions or exceptions claimed by persons in that building.

(c) It shall be deemed a violation of this part for an owner or operator to knowingly provide false, misleading or incomplete information on the "Building Compliance Information Form" or the "Certificate of Building Compliance."

(d) DOE will make "Certificates of Building Compliance" and "Building Compliance Information Forms" and instructions available at convenient locations throughout the country. In addition, "Certificates of Building Compliance" and "Building Compliance Information Forms" and instructions for their completion may be obtained from the Office of Emergency Conservation Programs at the address listed in the For Information Contact section of this notice.

Subpart F—Administrative Procedures

§ 490.51 Purpose and scope.

This subpart establishes the procedures for determining the nature and extent of violations of section 524(c) of the EPCA and the procedures for issuance of a Notice of Violation, Violation Order, Violation Order for Immediate Compliance, Modification or Rescission Decision and Order, and Stay Decision and Order. Nothing in these regulations shall affect the authority of DOE enforcement officials in coordination with the Department of Justice to initiate appropriate civil or criminal enforcement actions in court at any time.

§ 490.52 Notice of violation.

(a) When any audit or investigation discloses, or the DOE otherwise finds, that any person has engaged, is engaged, or is about to engage in acts or practices contrary to the provisions of Standby Conservation Plan No. 2 (Emergency Building Temperature Restrictions) and implementing regulations in violation of section 524(c) of the EPCA, the DOE may issue a Notice of Violation. Any notice issued under this section shall be in writing and shall set forth the findings of fact and conclusions of law upon which it is based.

(b) Within 10 business days after the service of a Notice of Violation the person upon whom the Notice is served may file a reply with the DOE office that issued the Notice of Violation. The DOE may extend the 10-day period for good cause shown.

(c) The reply shall be in writing and signed by the person filing it. The reply shall contain a statement of all relevant facts pertaining to the acts or practices that are the subject of the Notice of Violation. The reply shall include a statement of the legal, business and other reasons for the acts or practices; a description of the acts or practices; and a discussion of the pertinent provisions and relevant facts reflected in any document submitted with the reply. Copies of all relevant contracts, reports, abstracts, compilations of data and other documents shall be submitted with the reply. The reply shall include a discussion of the relevant authorities which support the position asserted, including rulings, regulations, interpretations, orders and decisions issued by DOE.

(d) The reply should indicate whether the person requests an informal conference regarding the notice. A request for a conference must be in writing and shall be governed by the provisions of 10 CFR 205.171, which are incorporated by reference herein and made a part of this subsection.

(e) If a person has not filed a reply with the DOE within the 10-day or other period authorized for reply, the person shall be deemed to have admitted the accuracy of the factual allegations and legal conclusions stated in the Notice of Violation, and the DOE may proceed to issue a Violation Order in accordance with § 490.53.

(f) If the DOE finds, during or after the 10-day or other period authorized for reply, that no violation has occurred, is continuing, or is about to occur, or that for any reason the issuance of a Violation Order would not be appropriate, it shall rescind the Notice of Violation and inform the person to whom the Notice was issued of the rescission.

§ 490.53 Violation Order.

After considering all information received during the proceeding, the DOE may issue a Violation Order. The Violation Order may adopt the findings and conclusions contained in the Notice of Violation or may modify or rescind any such finding or conclusion to conform the Order to the evidence or on the basis of a determination that the finding or conclusion is erroneous in fact or law or is arbitrary or capricious. Such Order shall constitute a final agency order subject to judicial review. Unless otherwise specified, the Violation Order shall be effective 10 business days after the date of issuance. In the alternative, the DOE may determine that no Violation Order should be issued or that the Notice of Violation should be withdrawn for further consideration or modification. Every determination made pursuant to this section shall state the relevant facts and legal bases supporting the determination.

§ 490.54 Violation Order for Immediate Compliance.

(a) Notwithstanding the provisions of § 490.52 or § 490.53, the DOE may issue a Violation Order for Immediate Compliance, which shall be effective upon issuance and until rescinded or suspended, if it finds:

(1) There is a strong probability that a violation has occurred, is continuing or is about to occur;

(2) Irreparable harm will occur unless the violation is remedied immediately; and

(3) The public interest requires the avoidance of such irreparable harm through immediate compliance and waiver of the procedures afforded under § 490.52.

(b) A Violation Order for Immediate Compliance shall be served promptly upon the person against whom such Order is issued by personal service, telex or telegram, with a copy served by registered or certified mail. The copy shall contain a written statement of the relevant facts and the legal basis for the Violation Order for Immediate Compliance, including the findings required by paragraph (a) of this section.

(c) The DOE may rescind or suspend a Violation Order for Immediate Compliance if it appears that the criteria set forth in paragraph (a) of this section are no longer satisfied. When appropriate, however, such a suspension or rescission may be accompanied by a Notice of Violation issued under § 490.52.

(d) If at any time in the course of a proceeding commenced by a Notice of Violation the criteria set forth in paragraph (a) of this section are satisfied, the DOE may issue a Violation Order for Immediate Compliance, even if the 10-day period for submitting a reply to that document has not expired.

§ 490.55 Modification or rescission.

(a) Any person to whom a Violation Order or Violation Order for Immediate Compliance is directed may make application for modification or rescission of such Order.

(b) The application shall contain a full and complete statement of all relevant facts pertaining to the circumstances, act or transaction that is the subject of the application and to the DOE action sought; and shall include a discussion of the relevant authorities which support the position asserted, including, but not limited to, DOE rulings, regulations, interpretations and decisions. The applicant shall fully describe the events, acts or transactions that comprise the significantly changed circumstances, as defined in paragraph (e)(2) of this section, upon which the application is based. The applicant shall state why, if the significantly changed circumstance is new or newly discovered facts, such facts were not or could not have been presented during the prior proceeding.

(c) The application should indicate whether the person requests an informal conference. A request for a conference must be in writing and shall be governed by the provisions of 10 CFR 205.171, which are incorporated by reference herein and made a part of this subsection.

(d)(1) If the DOE determines that there is insufficient information upon which to base a decision and if upon request the necessary additional information is not submitted, the DOE may dismiss the application without prejudice. If the failure to supply additional information is repeated or willful the DOE may dismiss the application with prejudice.

(2)(i) If the applicant fails to satisfy the requirements of paragraph (b) of this section, the DOE shall issue an order denying the application. The order shall state the grounds for the denial.

(ii) The order denying the application shall become final within 5 days of its service upon the applicant, unless within such 5-day period an amendment to correct the deficiencies identified in the order is filed with the DOE.

(iii) Within 5 days of the filing of such amendment, the DOE shall notify the applicant whether the amendment corrects the specified deficiencies. If the amendment does not correct the deficiencies, the notice shall be an order dismissing the application as amended. Such order shall be a final agency order subject to judicial review.

(e) *Criteria.* (1) An application for modification or rescission of an order shall be processed only if the application demonstrates that it is based on significantly changed circumstances.

(2) For purposes of this subpart, the term "significantly changed circumstances" shall mean—

(i) The discovery of material facts that were not known or could not have been known at the time of the proceeding and action upon which the application is based;

(ii) The discovery of a law, regulation, interpretation, ruling, order or decision that was in effect at the time of the proceeding upon which the application is based and which, if such had been made known to the DOE, would have been relevant to the proceeding and would have substantially altered the outcome; or

(iii) There has been a substantial change in the facts or circumstances upon which an outstanding and continuing order of the DOE affecting the applicant was issued, which change has occurred during the interval between issuance of such order and the date of the application and was caused by forces or circumstances beyond the control of the applicant.

(f) Upon consideration of the application and other relevant information received or obtained during the proceeding, the DOE shall issue an order granting or denying the application. The order shall include a written statement setting forth the relevant facts and the legal basis of the order. Such order shall be a final agency order subject to judicial review.

§ 490.56 Stay pending judicial review.

(a) Any person to whom a Violation Order or Violation Order for Immediate Compliance is directed may make application for a stay of such Order pending judicial review.

(b) The application shall contain a full and complete statement of all relevant facts pertaining to the act or transaction that is the subject of the application and to the DOE action sought. Such facts shall include, but not be limited to, all information that relates to the satisfaction of the criteria in paragraph (e) of this section. A copy of the Order from which a stay is sought shall be included with the application.

(c) If the DOE determines that there is insufficient information upon which to base a decision and if upon request additional information is not submitted by the applicant, the DOE may dismiss the application without prejudice. If the failure to supply additional information is repeated or willful, the DOE may dismiss the application with prejudice.

(d) The DOE shall grant or deny the application for stay within 5 business days after receipt of the application.

(e) *Criteria.* The grounds for granting a stay are:

(1) A showing that irreparable injury will result in the event that the stay is denied;

(2) A showing that denial of the stay will result in a more immediate serious hardship or gross inequity to the ap-

plicant than to the other persons affected by the proceeding;

(3) A showing that it would be desirable for public policy or other reasons to preserve the status quo ante pending a decision on the merits of the appeal or exception;

(4) A showing that it is impossible for the applicant to fulfill the requirements of the original order; and

(5) A showing that there is a likelihood of success on the merits.

(f) Upon consideration of the application and other relevant information received or obtained during the proceeding, the DOE shall issue an order granting or denying the application. The order shall include a written statement setting forth the relevant facts and the legal basis of the decision, and the terms and conditions of the stay.

(g) The grant or denial of a stay is not an order of the DOE subject to administrative review.

§ 490.57 Consent order.

(a) Notwithstanding any other provision of this Subpart, the DOE may at any time resolve an outstanding compliance investigation or proceeding with a Consent Order. A Consent Order must be signed by the person to whom it is issued, or a duly authorized representative, and must indicate agreement to the terms contained therein. A Consent Order need not constitute an admission by any person that DOE regulations have been violated, nor need it constitute a finding by the DOE that such person has violated DOE regulations. A Consent Order shall, however, set forth the relevant facts which form the basis for the Order. A Consent Order is a final Order of the DOE having the same force and effect as a Violation Order issued pursuant to § 490.53.

(b) At any time and in accordance with the procedures of § 490.55, a Consent Order may be modified or rescinded upon petition by the person to whom the Consent Order was issued, and may be rescinded by the DOE upon discovery of new evidence which is materially inconsistent with the evidence upon which the DOE's acceptance of the Consent Order was based.

(c) Notwithstanding the issuance of a Consent Order, the DOE may seek civil or criminal penalties or compromise civil penalties pursuant to Subpart G concerning matters encompassed by the Consent Order, unless the Consent Order by its terms expressly precludes the DOE from so doing.

(d) If at any time after a Consent Order becomes effective it appears to the DOE that the terms of the Consent Order have been violated, the DOE may refer such violations to the Department of Justice for appropriate action in accordance with Subpart G of this part.

§ 490.58 Remedies.

A Violation Order, a Violation Order for Immediate Compliance, a Modification or Rescission Decision and Order, or a Consent Order may require the person to whom it is directed to make an appropriate adjustment in building or domestic hot water temperature, to post a correct Certificate of Building Compliance, and to take such other action as the DOE determines is necessary to eliminate the effects of a violation.

Subpart G—Investigations, Violations, Sanctions, Injunctions, and Judicial Actions

§ 490.61 Investigations.

Investigations will be conducted in accordance with the provisions set forth in 10 CFR 205.201.

§ 490.62 Violations.

Any practice that circumvents or contravenes or results in a circumvention or contravention of the requirements of any provision of this part or any order issued pursuant thereto is a violation of the regulations stated in this part.

§ 490.63 Sanctions.

(a) *General.* Any person who violates any provision of this part or any Order issued pursuant thereto shall be subject to penalties and sanctions as provided herein.

(1) The provisions herein for penalties and sanctions shall be deemed cumulative and not mutually exclusive.

(2) Each day that a violation of the provisions of this chapter or any order issued pursuant thereto continues shall be deemed to constitute a separate violation within the meaning of the provisions of this chapter relating to criminal fines and civil penalties.

(b) *Civil penalties.* (1) Any person who violates any provision of this part or any order issued pursuant thereto shall be subject to a civil penalty of not more than $5,000 for each violation.

(2) The DOE may at any time refer a violation to the Department of Justice for the commencement of an action for civil penalties. When the DOE considers it to be appropriate or advisable, it may compromise, settle and collect civil penalties.

(c) *Criminal penalties.* (1) Any person who willfully violates any provision of this part or any order issued pursuant thereto shall be fined not more than $10,000 for each violation.

(2) The DOE may at any time refer a willful violation to the Department of Justice for criminal prosecution.

(d) *Other penalties.* Willful concealment of material facts or false or fictitious or fraudulent statements or representations, or willful use of any false writing or document containing false, fictitious or fraudulent statements pertaining to matters within the scope of section 524(c) of the EPCA by any person shall subject such person to the criminal penalties provided in 18 U.S.C. 1001 (1970).

§ 490.64 Injunctions.

Whenever it appears to the DOE that any person has engaged, is engaged, or is about to engage in any act or practice constituting a violation of any regulation or order issued under this chapter, the DOE may request the Attorney General to bring an action in the appropriate district court of the United States to enjoin such acts or practices and, upon a proper showing, a temporary restraining order or a preliminary restraining order or a preliminary or permanent injunction shall be granted without bond. The relief sought may include, without limitation, a mandatory injunction commanding any person to comply with any such order or regulation.

PARTS 491–499 [RESERVED]

FINDING AIDS

A list of CFR titles, subtitles, chapters, subchapters and parts and an alphabetical list of agencies publishing in the CFR are included in the CFR Index and Finding Aids volume to the Code of Federal Regulations which is published separately and revised annually.

Material Approved for Incorporation by Reference
Table of CFR Titles and Chapters
Alphabetical List of Agencies Appearing in the CFR
List of CFR Sections Affected 10 CFR 400-499

Material Approved for Incorporation by Reference

The Director of the Federal Register has approved under 5 U.S.C. 552(a) and 1 CFR Part 51 the incorporation by reference of the following publications. This list contains only those incorporations by reference effective as of the revision date of this volume. Incorporations by reference found within a regulation are effective upon the effective date of that regulation. For more information on incorporation by reference, see the preliminary pages of this volume.

10 CFR CHAPTER II (PARTS 400–499)
DEPARTMENT OF ENERGY

	10 CFR
Part 420 State energy conservation plans	
American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc. 345 E. 47th St., New York, NY 10017	
Standard 90, Energy Conservation in New Building Design, Sections 4–9 (Aug. 11, 1975).	420.2; 420.7
Part 430-Energy conservation program for consumer products	
Air-Conditioning and Refrigeration Institute 1815 N. Fort Myer Drive, Arlington, VA 22209	
ARI 210–79 Standard for Unitary Air Conditioning Equipment	Part 430, Subpart B, Appendix M
ARI 240–77 Standard for Air-Source Unitary Heat Pump Equipment	Part 430, Subpart B, Appendix M
ARI 280–74 Standard for Central Forced-Air Electric Heating Equipment.	Part 430, Subpart B, Appendix N
ARI 320–76 Standard for Water Source Heat Pumps	Part 430, Subpart B, Appendix M
ARI 610–74 Standard for Central System Humidifiers	Part 430, Subpart B, Appendix K1
American National Standards Institute 1430 Broadway, New York, NY 10018	
ANSI B38.1–1970 Method of testing for Household Refrigerators, Combination Refrigerator Freezers and Household Freezers.	Part 430, Subpart B, Appendix A and B
ANSI B149.1–1972 Dehumidifiers	Part 430, Subpart B, Appendix L
ANSI C16.13–1961 Monochrome Television Broadcast Receivers	Part 430, Subpart B, Appendix H
ANSI Z11.182–1965 (R 1971), Standard Method of Test for Smoke Density in the Flue Gases from Distillate Fuels (ASTM D 2156–65 (1975)).	Part 430, Subpart B, Appendix N and O
ANSI Z21.10.1–1975 Gas Water Heaters	Part 430, Subpart B, Appendix E
ANSI Z21.11.1–1974 ANS for Gas-Fired Room Heaters, Vol. 1, Vented Room Heaters.	Part 430, Subpart B, Appendix O
ANSI Z21.13–1974 ANS for Gas-Fired Low Pressure Steam and Hot Water Heating Boilers.	Part 430, Subpart B, Appendix N

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ANSI Z21.44–1973 Gas Fired Gravity and Fan Type Direct Vent Wall Furnaces.	Part 430, Subpart B, Appendix O
ANSI Z21.47–1978 Gas Fired Central Furnaces	Part 430, Subpart B, Appendix N and O
ANSI Z21.48–1976 Gas Fired Gravity and Fan Type Floor Furnaces	Part 430, Subpart B, Appendix O
ANSI Z21.49–1975 Gas Fired Gravity and Fan Type Vented Wall Furnace.	Part 430, Subpart B, Appendix O
ANSI Z91.1–1972 ANS Performance Requirements for Oil-Powered Central Furnaces.	Part 430, Subpart B, Appendix N
ANSI Z224.1–1971 Performance Evaluation Procedures for Household Washers (AHAM HLW–1, Dec. 1971).	Part 430, Subpart B, Appendix J
ANSI Z234.1–1972 Room Air Conditioners	Part 430, Subpart B, Appendix F
ANSI Z235.1–1972 Appliance Humidifier Standard (AHAM HU–1–72)	Part 430, Subpart B, Appendix K2
American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. 345 E. 47th St., New York, NY 10017	
ASHRAE Standard 16–69 Method of Testing for Rating Room Air Conditioners.	Part 430, Subpart B, Appendix F
ASHRAE Standard 37–78 Method of Testing for Rating Unitary Air Conditioning and Heat Pump Equipment.	Part 430, Subpart B, Appendix M
American Society for Testing and Materials 1916 Race St., Philadelphia, PA 19103	
ASTM D 396–78 Standard Specification for Fuel Oils	430.2
ASTM D 2156–65 (1975) Method of Test for Smoke Density in Flue Gases from Distillate Fuels (ANSI Z 11.182–1965 (R 1971)).	Part 430, Subpart B, Appendix N and O
Association of Home Appliance Manufacturers 20 N. Wacker Dr., Chicago, IL 60606	
AHAM HLD–1, June 1974 Performance Evaluation Procedure for Household Tumble Type Clothes Dryers.	Part 430, Subpart B, Appendix O
AHAM HLD–2EC, Dec. 1975 Test Method for Measuring Energy Consumption of Household Tumble Type Clothes Dryers.	Part 430, Subpart B, Appendix D
AHAM HLW–2EC, Dec. 1975 Test Method for Measuring Energy Consumption of Household Clothes Washers.	Part 430, Subpart B, Appendix J
AHAM HLW–1, Dec. 1971 Household Washer Performance Evaluation Procedure. (ANSI Z 224.1–1971).	Part 430, Subpart B, Appendix J
AHAM HU–1–72, Appliance Humidifier Standard (ANSI Z 235.1–1972)	Part 430, Subpart B, Appendix K2
AHAM HRF–2–ECFT–1975 Test Procedures to Determine the Temperature and Energy Consumption of Household Refrigerators, Combination Refrigerator-Freezers, and Freezers.	Part 430, Subpart B, Appendix A and B
Hydronics Institute 35 Russo Pl., Berkeley Heights, NJ 07922	
Testing and Rating Standards for Cast Iron and Steel Heating Boilers, Jan. 1977.	Part 430, Subpart B, Appendix N
Underwriters Laboratories Inc. 207 E. Ohio St., Chicago, IL 60611	
UL 729–1976 Standard for Safety: Oil-Fired Floor Furnaces	Part 430, Subpart B, Appendix O

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	10 CFR
UL 730–1974 Standard for Safety: Oil-Fired Wall Furnaces	Part 430, Subpart B, Appendix O
UL 896–1973 Standard for Safety: Oil-Burning Stoves	Part 430, Subpart B, Appendix O

Part 436—Federal energy management and planning programs

American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.
345 E. 47th St., New York, NY 10017

Standard 93–77 Methods of Testing to Determine the Thermal Performance of Solar Collectors.	436.76

Part 440—Weatherization assistance for low-income persons

Architectural Aluminum Manufacturers Association
35 East Wacher Drive, Chicago, Ill. 60601

ANSI/AAMA 302.9–1977	Part 440, Appendix A
ANSI/AAMA 402.9–1977	Part 440, Appendix A
ANSI/AAMA 1002.10–1983	Part 440, Appendix A
ANSI/AAMA 1102.7–1977	Part 440, Appendix A

American National Standards Institute, Inc.
1430 Broadway, New York, N.Y. 10018

ANSI Z21.8a	Part 440, Appendix A
ANSI Z21.17	Part 440, Appendix A
ANSI Z21.21	Part 440, Appendix A
ANSI Z21.47–1978	Part 440, Appendix A
ANSI Z21.66–1977	Part 440, Appendix A
ANSI Z21.67–1978	Part 440, Appendix A
ANSI Z21.68–1978	Part 440, Appendix A
ANSI Z21.71–1981	Part 440, Appendix A
ANSI Z83.1	Part 440, Appendix A
ANSI Z91.2	Part 440, Appendix A
ANSI Z98.2	Part 440, Appendix A
ANSI Z223.1–1980	Part 440, Appendix A

Air-Conditioning and Refrigeration Institute
1501 Wilson Blvd., Arlington, VA 22209

ARI 470–80	Part 440, Appendix A

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	10 CFR
ARI 1060–80	Part 440, Appendix A

American Society for Testing and Materials
1916 Race Street, Philadelphia, PA 19103

ASTM C208–82	Part 440, Appendix A
ASTM C509–79	Part 440, Appendix A
ASTM C516–80	Part 440, Appendix A
ASTM C517–71 (1979)	Part 440, Appendix A
ASTM C533–80	Part 440, Appendix A
ASTM C534–77	Part 440, Appendix A
ASTM C547–77	Part 440, Appendix A
ASTM C549–81	Part 440, Appendix A
ASTM C552–79	Part 440, Appendix A
ASTM C553–70 (1977)	Part 440, Appendix A
ASTM C570–72 (1978)	Part 440, Appendix A
ASTM C578–83	Part 440, Appendix A
ASTM C591–69	Part 440, Appendix A
ASTM C592–80	Part 440, Appendix A
ASTM C610–67 (1974)	Part 440, Appendix A
ASTM C612–77	Part 440, Appendix A
ASTM C665–78	Part 440, Appendix A
ASTM C669–72 (1981)	Part 440, Appendix A
ASTM C720–72 (1979)	Part 440, Appendix A
ASTM C726–81	Part 440, Appendix A
ASTM C728–82	Part 440, Appendix A
ASTM C755–73 (1979)	Part 440, Appendix A
ASTM C764–73 (1979)	Part 440, Appendix A
ASTM C834–76 (1981)	Part 440, Appendix A

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	10 CFR
ASTM C892-78	Part 440, Appendix A
ASTM C920-79	Part 440, Appendix A
ASTM C971-82	Part 440, Appendix A
ASTM D3678-81	Part 440, Appendix A
ASTM D4099-82	Part 440, Appendix A
ASTM E84	Part 440, Appendix A
ASTM E96-80	Part 440, Appendix A
American Society of Mechanical Engineers United Engineering Center, 345 East 47th Street, New York, NY 10017	
ASME CSD 1-1982	Part 440, Appendix A
ASME Boiler and Pressure Vessel Code (1980) Sections I-XI	Part 440, Appendix A
Federal Specifications, General Services Administration Specification Section, Room 6039, 7th and D Streets, SW, Washington, DC 20409	
F.S. HH-I-1972/1	Part 440, Appendix A
F.S. HH-I-1972/2	Part 440, Appendix A
F.S. TT-P-00791 B	Part 440, Appendix A
F.S. TT-S-001657	Part 440, Appendix A
F.S. TT-S-00230C	Part 440, Appendix A
Fur and Hemlock Door Association Yeon Building, Portland, Oregon 97204	
FHDA 7/79, sec. 3	Part 440, Appendix A
National Electrical Manufacturers Association 2101 L St., NW., Washington, DC 20037	
NEMA DC3-1978	Part 440, Appendix A
NEMA DC15-1979	Part 440, Appendix A
National Fire Protection Association Batterymarck Park, Quincy, MA 02269	
NFPA 31-1983	Part 440, Appendix A
National Woodwork Manufacturers Association 205 West Toughy Ave., Parkridge, Ill. 60068	
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For the period between January 12, 1974, when Title 10, Chapter II was established at 39 FR 744, and December 31, 1985, see the "List of Sections Affected, 1973-1985," Volume I.

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430 Authority citation revised	7550
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430.32 Removed	7550
430.33 Removed	7550
436.100—436.108 (Subpart F) Authority citation revised	4586
436.106 (a)(4) (vi) and (vii) redesignated as (a)(4) (iv) and (v)	4586
463 Form ERA-166 availability	593, 42994
477 Removed	31317

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10 CFR	52 FR Page
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420 Class deviation	18548
430 Authority citation revised	47550
430.22 (c)(1)(iii) and (2)(iii) added; eff. 2-16-88	47550
430.21—430.27 (Subpart B) Appendix C amended; eff. 2-16-88	47551
456 Revised; interim	6715
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458 Removed	34185
465 Class deviation	18548

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420 Class deviation	15801
420.2 Amended	52394
420.3 (e) and (f) added	52394
420.4 (b)(1) revised; (b)(4) added	52395
420.12 (a) (4) and (5) and (b) amended; (a)(6) removed; (e) added	52395
430.2 Amended	8311
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430.22 (m) revised	8311
430.23 (m) (2) through (7) revised	8312
430.21—430.27 (Subpart B) Appendix M amended	8313
435 Added; interim eff. 2-21-89	32545
465 Class deviation	15801

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430 Authority citation revised	6074
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430.1 Revised	6074
430.2 Amended	6074

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430.22 (a)(1)(ii), (2)(ii), (3)(ii), (4)(i) and (ii), (b)(1)(ii), (2)(ii), (3)(ii), (4)(i), and (ii) amended; (a)(6) and (b)(6) removed; (a)(5) and (b)(5) redesignated as (a)(6) and (b)(6) and revised; new (a)(5), (b)(5), (p), and (q) added	6075
430.23 Introductory text amended; (p) and (q) added	6075
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Appendix B1 amended	36241
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430.31—430.33 (Subpart C) Revised	6077
430.32 (a) revised; eff. 1-1-93	47943
(e) table amended; eff. 1-1-92	47944
430.40—430.49 (Subpart D) Revised	6078
430.50—430.57 (Subpart E) Added	6080
430.60—430.75 (Subpart F) Added	6081
430.60—430.75 (Subpart F) Appendix B corrected	11320
435 Authority citation revised	4553
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Corrected	50342
435.97—435.112 (Subpart A) Added	4554

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420.5 Revised; interim	3004
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420.9 Revised; interim	3004
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430.2 Corrected	996
430.22 (e) (1) and (2) revised; (e)(4) added; eff. 4-15-91	42169

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430.31 Amended; eff. 4-15-91	42177
430.32 (e) regulation at 54 FR 6077 effective date corrected	42162
(d) revised; (e) amended; (d) eff. 4-15-91	42177
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435 Standby loss criteria statement and response to comments	23842
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435.109 Table 9.3-1 revised	23869
436 Authority citation revised	48220
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455.110—455.115 (Subpart J) Added; interim	3006
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